SCIENTIFIC AMERICAN

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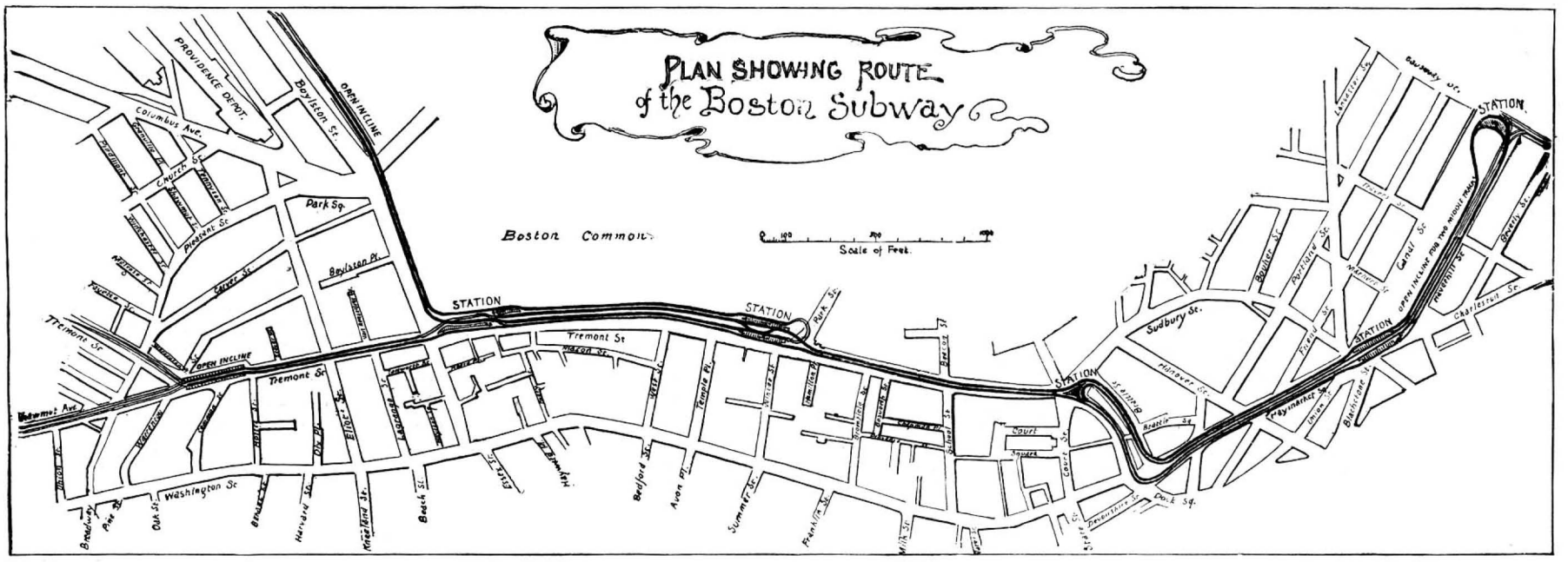

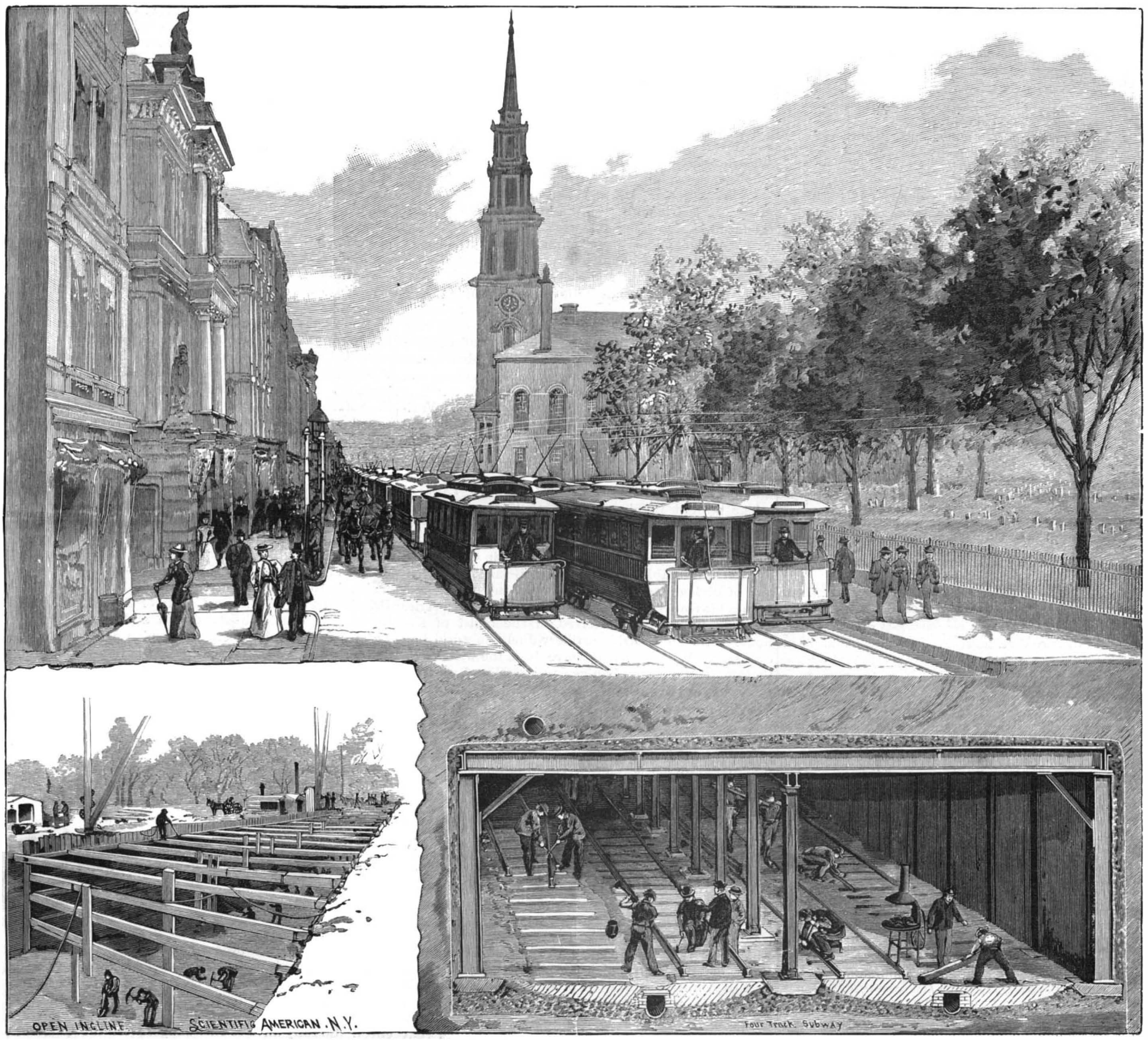

THE BOSTON SUBWAY FOR STREET CARS.—[See page 135.]

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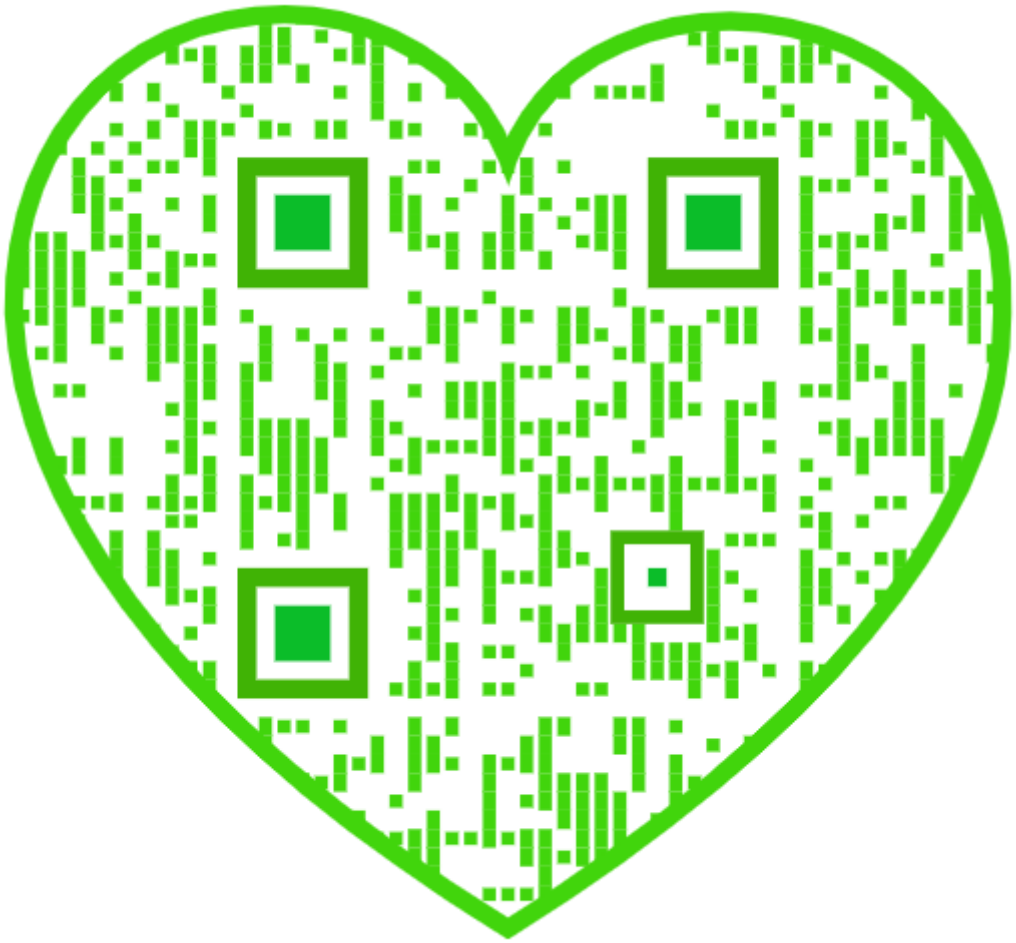

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NEW YORK, SATURDAY, AUGUST 31, 1895.

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

It is now forty-five years since this important association held its first meeting, under the presidency of Professor Edward Hitchcock. That was in Philadelphia, where the next meeting also was held. Annual meetings have been held ever since, in Boston, New Haven, Cincinnati, Albany, Cleveland, Washington, Montreal, Indianapolis, Toronto, Rochester, New York, Brooklyn, and other cities, mostly in the Northern States, although it was originally intended to alternate between the North and the South. One reason for the preference for the cooler latitudes is that it has been found necessary to hold the meetings during the summer vacation in order to accommodate the members connected with colleges and schools.

There are now 2,000 members enrolled, including nearly every eminent scientist in America, besides many persons who would claim only to be friends of scientific aims and pursuits. The attendance on the annual meetings varies from 200 to 1,000 members, besides the large number of casual visitors attracted to the public lectures and social entertainments. It is eminently a popular organization, aiming at the "advancement of science" by influencing the minds of the multitude, and seeking to stimulate scientific research far beyond the bounds of its limited membership.

It is now fifteen years since the A. A. A. S. has met in New England, although its official home is at Salem, Mass., and it was incorporated by a special act of the legislature of Massachusetts. It seems appropriate, therefore, that this year its anniversary should be held in the charming city of Springfield, where it convenes from August 28 to September 5, with excursions to follow and with affiliated societies meeting both before and after. At first the discussions and papers were all in general session. But as the work broadened it was found necessary to divide into nine sections, representing Mathematics and Astronomy, Physics, Chemistry, Mechanical Science and Engineering, Geology and Geography, Zoology, Botany, Anthropology, and Economic Science and Statistics. Even this subdivision was found to be insufficient, and the affiliated societies referred to were formed, namely, the Geological Society of America; the Society for Promotion of Agriculture; the Entomological Society; the Society of Engineers; the American Chemical Society; the American Forestry Association; the Association of State Weather Service, and the Botanical and other clubs, all of which usually meet during the association week.

Yet daily general meetings are held, for the election of officers, hearing of reports, and transaction of general business. Two or more free evening lectures are also given complimentary to the citizens of the locality, and there is free admission to the public addresses made by the president and the vice presidents.

The citizens of Springfield have made ample preparations for welcoming the large body of scientific guests who are expected this week, and many plans have been laid for their entertainment. The general sessions are held in the Y. M. C. A. building; the presidential address will be given in the Court Square Theater; and the general reception will be in the City Hall. The hotel headquarters are at the Worthy Hotel. Various neighboring cities have extended invitations and arranged for excursions enabling the guests to visit many points of scenic, historic, or scientific interest.

THE LESSONS OF THE BATTLE OF THE YALU.

The current number of the Century contains a graphic account of this battle, written by an eyewitness and active participant, Philo N. McGiffen, who was in command of the battle ship Chen Yuen on that memorable occasion. He disclaims all intention of giving a technical account of the action, and wishes his readers to regard the description as a series of vivid impressions, received in the midst of five hours of the most terrific artillery duel the world had ever seen. Whatever may have been the writer's intention, he has certainly given us a series of war pictures that are not merely fraught with tragic interest to the lay reader, but are also full of valuable lessons for the future guidance of the professional naval designer.

For the past forty years, or ever since armor was first placed upon a warship's sides, the science of warship design has been almost entirely theoretical. The nations of the earth have poured their wealth like water into the naval treasury, and the naval boards have spent it faster than it came to hand. Huge navies have been created on purely theoretical lines, and just how far these theories were correct and just what was the relative value of the many and diversified types of ships, guns and armor, no one, not even the experts, could tell.

It is true there had been a naval fight at Lissa, in which the ram, that classic weapon of Greece and Rome, had demonstrated its deadly power; it is true that the Chile-Peru war has produced one memorable sea fight in which gun contended with armor; and again, in the sinking of the Blanco Encalada, the torpedo, under modifying circumstances, showed that theory had proceeded along the right lines and had produced a weapon of appalling destructive power; but yet, taken for all in all, the experience gained had been very meager, in comparison to the thousand and one questions that were awaiting solution.

This solution was expected to come in the breaking out of the long-expected European war. To the surprise of every one, it was in the East, and not in the West, that the test was made. It was the semi-civilized races of the East that taught the Western nations the true value of their modern guns, ships and armor.

It has been contended that the test is not conclusive; that on the part of one, at least, of the combatants there was too much cowardice, irresolution and general incompetency, to render the results of much technical value. But we think that any one who reads this account by an eye-witness of the cool, dogged bravery of the Chinese gunners above deck and the Chinese engineers below deck; the one decimated by a murderous tempest of quick-fire shell, and the other slowly roasted in an engine room temperature of 200° (see description), we think that any reader must admit that the two Chinese ironclads were fought for all there was in them, and that the results of the fight furnish us with reliable data for future designs.

The chief interest of the battle centers in the two Chinese ironclads and the principal squadron of the Japanese. They fought out the fight all to themselves; the flying squadron of the Japanese, consisting of the lighter and swifter cruisers, directing their attention to the lighter armed Chinese ships. It was just such a test as the naval world had been looking for—swift, unarmored or lightly armored ships against slower but heavily armored battle ships. The four ships constituting the principal squadron were armed with one 12½ inch gun placed forward, amidships, in an armored barbette, and a secondary battery of lighter quick-fire guns. This 12½ inch gun is, in some respects, the most formidable gun afloat. Built by Canet, in France, it has extreme length, great velocity, and has a theoretical penetration at the muzzle of 50 inches of iron! Theoretically, the shot from this gun should have ripped the Chinese ships from end to end, and have pierced their 10 inch and 14 inch armor like so much cardboard. What are the facts? Says Commander McGiffen: "We were struck both on the 14 inch belt and 10 inch conning tower by the 12½ inch shells," but "no shot penetrated more than four inches." So that, if this be true (and the authority, surely, places it beyond question), the comparatively light and somewhat out of date armor of the Chen Yuen had about 70 per cent of resisting power to spare against the most powerful penetration of modern ordnance!

This proves to us what the writer has long believed, viz., that penetration as shown at the proving grounds will always be vastly in excess of the actual penetration in time of battle. The test shot is always fired normal to the plate, but in action not one shot in one hundred will strike normal to the plates on the curved, oblique, or spherical armored portions of a battle ship. With every degree of deviation from the normal at the point of impact, the shot has to travel that much further to pass in a diagonal line through the plate; and there is an extreme angle at which it will refuse to "bite" at all, and will glance away, inflicting comparatively little damage. Unquestionably this is what happened in the majority of cases where the shots struck the armored portions of the Chinese ships.

Another lesson of the fight is that a heavily armored barbette, placed high above the water line, and resting upon a light unarmored substructure, is a mistake. The opponents of this system of construction, which is to be found in the Admiral class of Great Britain's navy, and in the turrets of the 8 inch guns in our own battle ships Indiana and Oregon, have claimed that a well-directed shell, placed beneath the floor of these barbettes, would wreck the whole gun and mountings, and disable the gunners. This is precisely what happened when the Chinese Chen Yuen, by a well-directed shot at 1,700 meters from her 12 inch gun, killed 49 and wounded 50 men on the Japanese Matsushima, and totally disabled her 12½ inch gun, which was mounted as above described.

Though the heavy guns fell so far below their theoretical effectiveness, the larger class of quick-fire guns, the 4·7 inch and 6 inch, proved to be fully as terrible in their destructive effect as was anticipated. At distances varying from 1,000 to 3,000 meters they poured in a perfect tempest of armor-piercing shells, against which the light 1 inch and 2 inch shields of the Chinese were worse than useless. It seems that these light shields are a positive source of danger to the gun crews they are supposed to protect. Too weak to keep out the quick-fire shells, they are yet stout enough to give the percussion necessary to explode the shells that pass through them. These shields thus became, in the words of Commander McGiffen, "veritable man-traps." They simply inclosed the flying fragments of the bursting shells, and concentrated their destructive effect. So fully alive to this danger were the Chinese

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commanders, that they actually removed the 30 foot circular one inch shields that covered the barbettes; claiming that they would only serve to intercept and explode shells which otherwise would pass harmlessly overhead. These shields were designed to keep out the smaller machine gun shot; but as the fight was carried out at long range, "the value of shot smaller than 3 lb." was "questionable" at least under such conditions. The value of superior speed was clearly established. The Japanese ships, with their 17½ knots speed, simply played with their slower antagonists, and appeared to have followed out their own plan of tactics at will. They came down diagonally on the Chinese fleet, in line ahead, at 12 knots speed; the forward half circling round the right flank of the Chinese line and returning along their rear. Thus they had the long-drawn-out Chinese line of battle between two fires. Their formation was soon broken; and the two Chinese ironclads, like lions at bay, were the center round which the Japanese principal squadron circled, sweeping them with a murderous fire at long range.

Superior speed is to the modern warship what the weather gage was to the frigate in the days of sail-driven ships—it gives the power of accepting or refusing battle. The faster ship can choose her position, and place herself at what range she pleases. The Japanese ships fought at long range, and thus neutralized the superior advantage afforded by the heavy armor of the enemy as compared with their own lighter protection.

It was also clearly shown in this engagement that the use of wood, or any combustible material, in the construction of a fighting ship, should be kept down to the lowest possible limit. Time and again the Chinese ships were set on fire by the quick-fire shells that came aboard; and the crews had to leave their guns and fight the flames that broke out continually from the wooden partitions and deck houses. Decks, cabins and passageways will in future be built of light plating—or at least such parts of them as lie above the water line. In the meetings of the Naval Institute of Great Britain it has often been urged that the first naval battle would show that the fight would be won by destroying the crew and not the ship. The event has proved the surmise to be nearly correct. Much of the so-called gun protection was no protection at all; and gun positions were rendered untenable by the fearful hail of fifty pound and ninety pound quick-fire shells that swept them. Much of the weight that is now devoted to guns might with advantage be devoted to the encircling of fewer guns with heavy six-inch shields and casements. Five guns with effective protection are better than ten with none, or next to none.

There was one cause of fatalities on the Chinese ships that was certainly unexpected and unprovided for. It appears that the conning tower was situated high up and between the barbettes. Many of the shot that rebounded from this tower fell into the barbettes; and more of the crew were disabled in this way than by the direct fire of the enemy.

In conclusion, summing up, we may say that the modifications to be looked for in future designs are:

1.—A more extended use of stout side armor, with a tendency to carry water line armor completely fore and aft; as in the French and Russian ships.

2.—In the case of armored barbettes or turrets, the extending of the armor down to a connection with the water line belt; so that the protection from axis of gun down to water line may be complete.

3.—Fewer guns with heavier shields.

4.—The elimination of all wood or combustible material from the construction.

5.—As far as compatible with the above desiderata, an increase in the speed. J. B. W.

Cycle Notes.

While the American manufacturers contemplate increasing the size of bicycle tires on the '96 models, the English firms intend to adopt the reverse style. An English manufacturer in speaking of the tire question says: "If anything, we shall reduce the size of our tires, and with very good reason, I think. On theory the larger sized tires ought to be more comfortable, but in practice I do not think they will generally be found so. Large tires mean added weight, and that, too, just where it will detract most from speed. For general road work during the past season we have used 1¾ inch tires mostly, and for light wheels 1⅝ inch. The indications are that next season will see 1⅝ inch tires used very freely and 1½ inch used for the light wheels."

In a Wisconsin village a funeral procession was very largely made up of men and women on bicycles, the deceased having been a member of the bicycle club.

The two advantages claimed for tandem bicycles are the absence of vibration when riding over a rough road and the ease with which two riders can propel the machine against a head wind.

The various trade papers devoted to cycling have a total circulation of over 100.000. Among them are the following: Bearings, Cycling Life, the L. A. W. Bulletin, and the Referee; these are all published in Chicago. In New York City we have the Bowling and Cycling Gazette, the Wheel and Cycling Trade Review, and the American Wheelman and Cycle Trade Gazette. The Wheeling American is published at Nunda, N. Y. In Philadelphia are published American Cycling and the Cycle Guide. The Bicycling World is published in Boston, and the American Cycle in Hartford, Conn. The Wheelmen's Gazette is published in Indianapolis, Ind. The Michigan Cycle at Grand Rapids, Michigan. The Western Sportsman and Bicycle Reporter, Kansas City, Loose Spokes is published at Moorestown, N. J. The Pneumatic is published at Milwaukee, Wis., and the L. A. W. Pointer at Oshkosh. Farther West we have the Cycling and Sportsman, which is published at Dallas, Tex., the Cycling West, Denver, Col., and the Northwest Sportsman and Cyclist, Portland, Ore. In Canada there is the Canadian Wheelman, published at Simcoe, Ont., and Cycling, which is published at Toronto, Canada. The Wheelwoman, which is conducted by Mary Sargent Hopkins, is published at Boston, Mass., and is one of the latest additions to cycling periodical literature. It is a very handsomely gotten up monthly.

Belgium wheelmen are not only taxed, but they must at all times carry with them their tax receipt, so that they may be able to show the same to any inquiring official.

A new tire has been invented, called the ball-bearing bicycle tire. The objection to the ordinary tube tires is that a puncture in one place destroys the usefulness of the whole tire until the puncture is repaired. The new tire consists of a closed rubber tube, filled with hollow elastic balls of the same diameter as the internal diameter of the tube. These balls are vulcanized and inserted in the tube during the process of manufacture. The tube may first be vulcanized, however, and the balls inserted through an opening which is afterward closed. It is said that additional elasticity and rigidity is imparted to the tire by the insertion of these hermetically sealed elastic balls, and, as each ball is an independent cushion, it would require puncture of several balls to make the tire useless. Another curious pneumatic ball tire has been patented in England, substituting for the continuous tubular tire a series of rubber balls, set in cups at the outer end of the spokes; the balls are so arranged that they may be simultaneously inflated. Several advantages are claimed for this device, one of them being that no serious inconvenience will follow the puncturing of one or two of the balls. It is also claimed that there is a great saving of ground cohesion, and this will increase the ease and speed of propulsion.

Atlanta Exposition Notes.

The electric fountain will compare with that of the Chicago Exposition. The water will rise 180 feet and will flow at the rate of 150,000 gallons a minute.

The forestry exhibit promises to be the most complete and instructive ever made by the government, exceeding in excellence, though not in size, the exhibit at Chicago in 1893. The wide range in the use of wood in all phases of human life will be shown. Large panels are already hung on the pillars of the building, each representing one particular line of use; as, for instance, wood in the kitchen, wood in the laundry, in sports, in the garden, in tools, etc.

The lumber exhibit will be so complete that any one may trace the growth of the tree through various stages, learn its adaptability to various commercial uses, its value, durability, comparative worth for special uses, etc.

Remarkable Railway Speed in Great Britain.

LONDON, August 23.—The London and Northwestern Railway Company's new fast train between London and Aberdeen, which left London at 8 o'clock p. m., August 22, arrived at Aberdeen at 4:32 o'clock a. m., August 23. Part of the journey of 540 miles was covered at the rate of seventy-five miles an hour.

This eclipses anything before recorded. To make this time, the average speed maintained must have been 63·47 miles an hour, including all stops.

No American railroad can show anything like this for long runs, although on short runs better time has been made.

On the New York Central the best time has been 436½ miles in 439½ minutes, including stops.

St. Louis' Speed Test.

The speed made by the St. Louis, August 20, on her official speed trial in the English Channel for acceptance as an auxiliary cruiser in the United States navy resulted in her showing a sustained speed of 22·3 knots per hour.

When she went into the dock at Southampton, prior to this trial, it was found that the bottom was in a very foul condition, being covered with grass a foot long. The St. Louis by her present performance wins a mail-carrying contract for ten years, at the rate of $4 per mile of a weekly service between New York and Southampton. The contract to take effect October 12.

Fascination by Snakes.

BY HAROLD S. FERGUSON, F.L.S.

No error is apparently more rooted in the human mind than that which attributes to snakes a peculiar power called "fascination," which they are believed to be capable of voluntarily exercising. By this power they are said to be able so to paralyze their victims that they are rendered utterly incapable of movement, and wait for the attack of a snake, or even go forward to meet it, in fear and trembling, but without any power of retaliation. Now any one who watches the behavior of small animals placed alive as food in the cages in which snakes are kept in captivity, in the hope of seeing this marvelous power in operation, will be grievously disappointed; chickens, rats, guinea pigs, rabbits, all move about with an utter absence of fear of the snakes. It may be said that all these are more or less domesticated animals, and have no hereditary dread of their natural enemy; but wild rats, placed in the cage of their particular pursuer, the rat snake of India (Zamenis mucosus), exhibit an absence of fear.

How, then, is it possible to account for the existence of the belief in the possession by snakes of the so-called power of fascination? It may have arisen from several causes. An observer may come on the scene and find a number of birds mobbing a snake just as they will mob an owl or kite. The dashes of the birds toward the snake and their fluttering round it may easily be put down to the effect of the snake's glance, while they are, in reality, merely the attempts of the birds to drive off the intruder. A mother bird whose young are attacked will almost certainly behave in this way, and may herself fall a victim, not to the power of fascination in the snake, but to the force of her maternal feelings. Then again it has been noticed that a hen placed in a snake's cage will often go toward it and make a determined peck at the snake's tongue. Dr. Stradling has also seen a frog doing the same thing.

Were this seen to occur in a wild bird, it might easily be put down to fascination. With regard to snakes that kill their prey by the injection of poison, it is even more easy to account for the appearance of the power, for they bite once and once only. The poison does not kill at once; the victim flutters on to a branch, it may be, or runs a short distance and stops, the snake watches it, the poison does its deadly work, and the bird falls. Any one who comes up not having seen the attack might in this way be readily deceived into imagining that it was the glance of the snake and not the poison that caused the victim to fall. It may be then the approach of an insectivorous bird or mammal who, taking the movements of the snake's tongue for those of a worm or insect, hopes to secure a meal. It may be the mobbing of the snake by the companions of a victim that has been seized, or of a mother whose nest has been robbed; it may be simply the effect of poison already injected before the observer has come upon the scene, or it may be simple curiosity.

These explanations should suffice to satisfy all those whose minds are not so filled with the love of mystery as to make them prefer to believe in the possession of this power, simply because it is mysterious, and, therefore, to refuse a common sense explanation.

In ninety-nine cases out of a hundred one or other of the above causes has been at work. What, then, of the hundredth case, and what about the fascination exercised on man, cases of which have undoubtly been recorded? The explanation lies in the probability that it is a case of hypnotism; it may be said, however, this is giving up the whole argument and admitting that a snake can fascinate, only it is calling the power by another name and saying that it can hypnotize. But this is not so. The snake does not hypnotize, the person is self-mesmerized; the action is purely subjective. Every one knows the school boy trick of holding a cock with its beak pressed against a table and drawing a chalk line from the tip of the beak along the table. The bird will remain in the position it has been placed in, though perfectly free to move. Now the snake no more exercises the power voluntarily than does the chalk line; position and tactile impression here produce hypnotism, and visual impression can produce it likewise. It is an error to suppose will power has anything to do with the effect. The matter has been taken up scientifically by the medical profession, especially in France, and it has been found that the hypnotic state of sleep or trance, or whatever it may be termed, can be produced by looking fixedly at the operator or at a coin or at the tip of one's own nose; it is not necessary to go into the question of how the result is brought about, but there is a physiological explanation. What happens then in the hundredth case is that the man or the animal may be self-hypnotized by gazing fixedly at the snake, the subject, being thus thrown into a sort of a trance, making no attempt to move out of danger, unless roused by some exterior influence.

We may conclude, then, that the attribution to snakes of the power of fascination is due to faulty observation and the drawing of conclusions from incorrect premises.—Science-Gossip.

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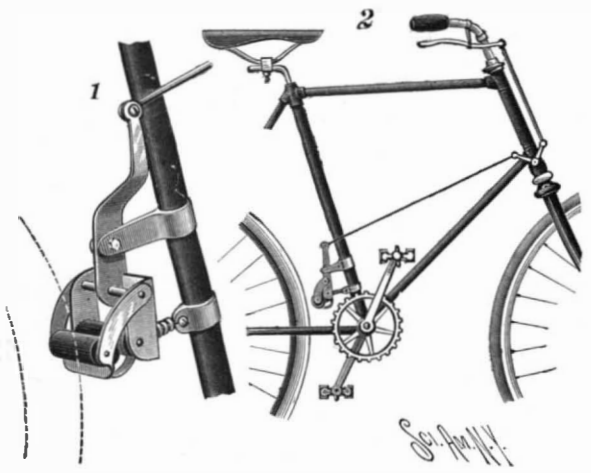
AN IMPROVED BICYCLE BRAKE.

The brake shown in the engraving, which has been patented by Richard T. Addy, of Wallingford, Conn., is designed when applied to efficiently brake the wheel without injuring or materially wearing the pneumatic tire. Fig. 1 is an enlarged view of the brake, whose position on the bicycle frame is shown in Fig. 2, the brake lever being fulcrumed in a clip on the upright bar and connected by a rod with a bell crank lever, from which a link extends to a handle lever on the handle bar. At the lower end of the brake lever is a casing in which is journaled a roller of rubber or other elastic material adapted to engage an

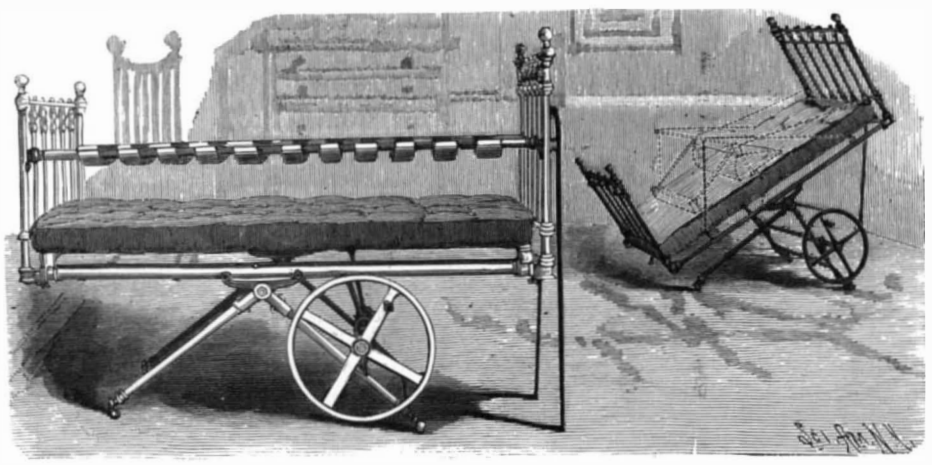


ADDY'S BICYCLE BRAKE.

adjacent brake roller journaled in a frame fulcrumed just above both rollers on the brake lever. The brake roller is held normally out of contact with the wheel by a spring connecting the lower end of the lever with the brake roller frame, and the brake lever is normally held in withdrawn position by a spring connecting its lower end with a clip on the connecting bar. By moving the handle lever, however, the rollers are brought into frictional contact with each other, and the brake roller is made to bear against the tire with a force proportioned to the pressure exerted on the handle lever, thus effectively braking the wheel, although the rotary motion of the rollers prevents especial wear of the tire.

THE GORHAM ADJUSTABLE BED.

A bed for invalids, so constructed as to permit of a great variety of adjustments, is shown in the accompanying illustration. It is manufactured by Fred F. Wheeler, No. 30 Beaver Street, Albany, N. Y. By means of a simple and easily operated mechanism, the patient may be given any desired position, and the bed line never be broken, whereby a fractured limb or diseased joint may remain immobilized and in line, whatever the position of the bed. The principal view represents long adjustable elevating bars, connected by webbing strips in place as when the bed is to be used for patients who are entirely helpless and who will need to be lifted frequently. The construction is such that the webbing may be released to allow it to lie slack upon the mattress, the strips being tightened to lift the patient. To elevate the patient on the webbing strips, a skeleton horse, such as stands at the head of the bed, is used. In the other view the bed is shown in inclined position and with the elevating bars removed, dotted lines indicating the position of a re-



THE GORHAM ADJUSTABLE BED.

movable seat and foot rest for supporting a patient comfortably in such position, and foldable supports for a table to be held in front of a patient. To give the bed any desired inclination, it is simply necessary to turn a hand wheel at the side, which operates a right and left hand screw that moves the arms that elevate or lower the bed. Both the seat and foot rest are conveniently adjustable as may best contribute to the comfort of the patient. This bed is designed to obviate bed sores and bed tire, is built to last a lifetime, and can be manipulated by a child to move the heaviest and most helpless patient. It has been warmly commended by doctors and surgeons who have tested it in practice. Mr. Wheeler issues an illustrated catalogue which is sent on application.

The Battleship Texas in Commission.

The United States battleship Texas, which we illustrated in our issue of January 19, 1895, was put into commission at the Norfolk Navy Yard at Portsmouth, Virginia, on August 15, 1895, in the presence of 500 visitors. On board was Rear Admiral George Brown and a number of other navy officers and prominent citizens.

The Texas was launched on June 28, 1892. The original plans were made by English designers, but these have since been considerably altered. The Texas is a twin screw, steel armored vessel of 6,335 tons normal displacement. She is driven by two sets of triple expansion engines capable of developing 5,800 horse power with natural draught and 8,600 horse power with forced draught. The vessel is 290 feet in length and 64 feet 1 inch wide. It has a mean draught of 22 feet 6 inches and will carry about 950 tons of coal. The main armament consists of two 12 inch breech-loading guns, each weighing 46½ tons, mounted in two turrets, one on either side of the forward deck. A secondary battery consists of four 6 pounder and four 3 pounder rapid-firing guns, with four 47 mm. Hotchkiss guns. All of these are mounted on the gun deck, with a 1½ inch plating to protect them. There are besides two Gatling guns and two 37 mm. Hotchkiss guns mounted on the bridge. The military tops and the flying bridge are provided with similar equipments.

The turrets are armored with 12 inches of steel and their bases are inclosed by a diagonal redoubt armored with 12 inch steel plates, which will also serve to protect the hydraulic machinery used for operating the guns and the smoke pipe casings. The boilers and engines are protected by a belt of armor 12 inches thick, extending 2 feet above the designed water line and 4½ feet below it, having a length of 116 feet. There is a protective deck built of 12 inch steel above the armor belt. The hull of the Texas is built on the cellular system and is constructed throughout of steel. A double bottom extends under the engines, boilers, and magazines, and is divided into numerous watertight compartments by longitudinal and transverse partitions. There are in all 129 of these compartments, and all are connected to steam and hand pumps by an extensive drainage system.

The boilers and engines are in watertight compartments.

The ship is lighted throughout with electricity.

The machinery for the Texas has been built by the Richmond Locomotive and Machine Works, of Richmond, Va.

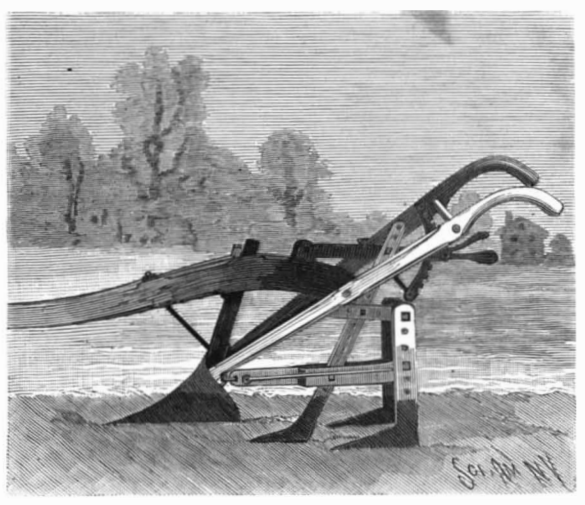
Alumina from Clay.

The following process is stated to yield excellent results. The clay is thoroughly incorporated with a mixture, in equal parts, of ammonia and potassium sulphates, in such proportion that three molecules of ammonium sulphate may be present to every molecule of alumina. The mixture is made into hollow bricks, which are then heated in an oven to 270°—280° C. At this temperature gaseous ammonia is given off, and acid ammonium sulphate produced, which immediately reacts with the potash salt present, acid potassium sulphate being formed. The latter, at the above temperature, combines with the alumina of the clay to form alum. The alum is finally extracted from the bricks by means of water, and freed from iron by recrystallization. The insoluble silica remaining behind may be employed in cements. Granular alumina is prepared as follows: The powdered alum is spread out in a thin layer on shelves arranged in a vertical tower, which is traversed by the warm, moist, ammoniacal fumes derived from the brick oven above mentioned. Under these conditions the alum is transformed in situ into alumina—retaining the form of the original powder—and potassium and ammonium sulphates. The latter may be subsequently removed by washing, and used over again. The alumina thus obtained is absolutely free from silica, and is readily convertible into sulphate, etc.—J. Heibling, Comptes Rend.

A GERMAN artisan's breakfast consists of coffee and bread; his dinner of soup made of water, slices of bread, slices of onion, and a little butter, meat once or twice a week; his supper, soup, cheese, potatoes and bread, with sausage and beer.

A SUBSOIL ATTACHMENT FOR PLOWS.

The illustration represents an attachment applicable to any style of plow, and which will not be in the way of plowmen, the subsoilers being adjustable vertically and laterally as required. The improvement has been patented by Theodore Woodard, of Garland, Kansas. A forward subsoiler is adapted to track the ordinary share, and two rear subsoilers each have a vertical apertured shank, the shanks being connected by cross bars, one of which carries a bifurcated beam whose forward end is connected with a staple on the stock of the main plow. Extending upwardly between the members of the beam is the apertured shank of the

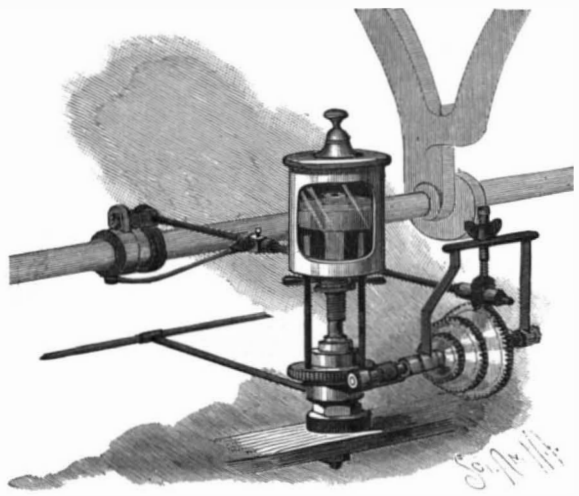


WOODARD'S SUBSOIL PLOW.

forward subsoiler, which is vertically adjustable, and is adjustably connected with the rear subsoilers by a link. The cross bars connecting the rear subsoilers are of sufficient length to permit the plows to be adjusted laterally. The entire attachment is raised and lowered by a lever fulcrumed on the rear of the plow beam and adjustably attached to the standard of the forward plow, the lever extending rearward between the handles and having a thumb latch engaging a rack on one of the handles.

AN IMPROVED LUBRICATOR.

A device to uniformly and forcibly feed the desired amount of lubricant to an object to be lubricated is represented in the accompanying illustration and has been patented by Charles P. Hogue and Joseph W. Smith, of Portland, Oregon (Box 2090, Station A). In the lubricant-containing vessel is a stationary piston on the upper end of a hollow stem from whose base piece extends a feed pipe to carry the lubricant to the object to be lubricated. On the under side of the bottom of the lubricant reservoir are half nuts, spring pressed to hold their threads in contact with a threaded portion of the hollow stem, and in the bottom of the reservoir are segmental slots engaged by pins extending up from a worm wheel, so that when the worm wheel is rotated the pins carry the vessel around, and it is moved downward on the threaded portion of the stem, forcing out the lubricant. The worm wheel rotates loosely on the lower part of the stem, and is in mesh with a worm on a transverse shaft carrying a series of graduated worm wheels on a common hub sliding on the shaft, which has a keyway engaged by a set screw. Either of the graduated worm wheels may thus be made to engage a worm on a shaft at whose other end is a worm in mesh with a worm on a



HOGUE AND SMITH'S LUBRICATOR.

line shaft, and the rotation of the latter actuates the different worms to turn the lubricant reservoir and force the lubricant through the hollow stem to the feed pipe and thence to the bearings to be lubricated, the feed ceasing when the line shaft stops. The half nuts engaging the hollow stem on the under side of the lubricant reservoir have handles, by which the operator may open the nuts and slide the vessel down by hand, to feed a large amount of lubricant at one time, and when the vessel is emptied the half nuts are similarly opened and the vessel raised to be refilled through its filling cap at the top.

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THE PROPOSED ATLANTIC COASTWISE AND CAPE COD CANALS.

When the history of civil engineering in this nineteenth century comes to be written, it is certain that the closing ten years will be called the decade of canal building. The Corinth Canal, in Eastern Europe; the Manchester Canal, in England; and the Kiel Canal, in Germany, are but just completed; and, in the Western Hemisphere, we have the great Nicaraguan Canal fully surveyed and large initial works in progress. Following close upon this we have now before us in the United States a proposal for the construction of two important inland waterways near the Atlantic seaboard; one of eight miles length, near Cape Cod; the other, and larger scheme, involving the construction of 31·4 miles of canal proper, and the deepening of 39 miles of navigable waterway between Philadelphia and New York.

It is proposed to utilize the Delaware River as far as Bordentown, dredging the channel to a depth of 28 feet. At this point the canal commences with a series of three locks, having a lift of 20 feet each, and giving a total rise of 60 feet.

The canal will be level at this elevation for its total length of 31·4 miles. It follows a natural topographical depression that runs across this part of New Jersey, at an average elevation of 60 to 100 feet above mean sea level. There will be another series of three locks, with a total fall of 60 feet, into the Raritan River, near Sayreville. Here again dredging will be necessary to secure a 28-foot channel up to the New York docks.

The preliminary borings are decidedly favorable to the cost of the undertaking. Between Delaware and Princeton, sand, gravel and clay are indicated, and beyond the latter point there is found only a comparatively small amount of red shales or sandstone. Upon these borings and surveys an estimate has been made of $14,574,100 for a 20-foot, and $24,124,700 for a 28-foot canal.

In consideration of the present cheapness of labor and materials, and the fact that a 15 per cent item for contingencies is included, this estimate would seem to be conservative; though it should be borne in mind that recent canals have cost from 30 to 50 per cent in excess of the preliminary estimate.

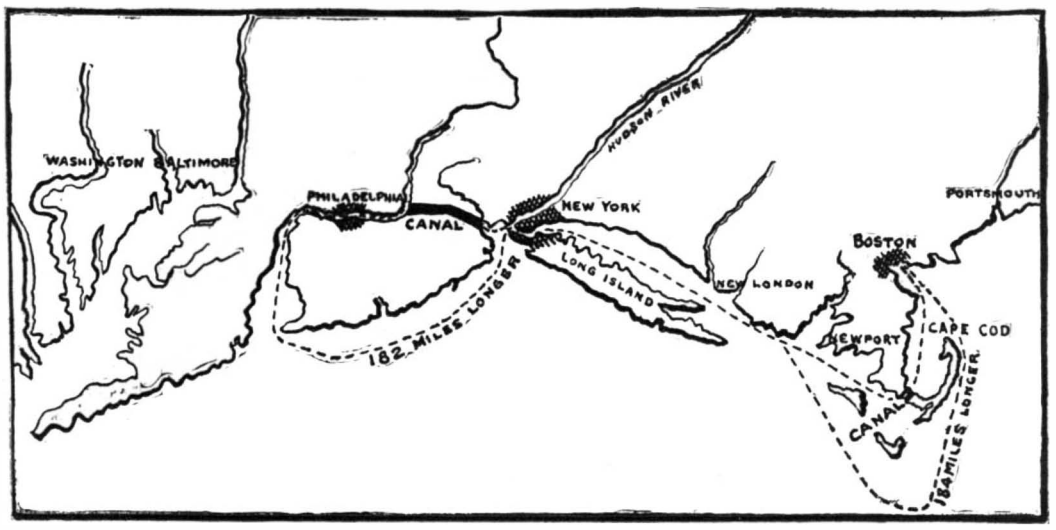
The commercial advantages are claimed to be:

1. A saving of 24 hours in the round trip to New York over the coastwise route.
2. The diminished risk in transportation.
3. The fact that a cheaper class of vessel can be used for this inland navigation.
4. There is a large coastwise trading done in barges in tow of separate tugs. An inland route would naturally attract a large portion of this somewhat risky system of deep water transportation. It is estimated that some 3,000,000 of tonnage that is at present towed in barges would seek this canal.

Not the least value of the scheme would lie in its strategic importance in time of war. Taken in connection with the Cape Cod Canal, it would shorten the distance between Philadelphia and Boston by some 450 miles, or about a day and a half's steaming for an average warship of to-day. In view of the scarcity of our warships in comparison to the extent of our coast line, such a reduction of distance would be of the highest strategic value.

The above facts in fuller detail are embodied in the report of the Canal Commission of Philadelphia to the Select and Common Councils of the city. The commission is thoroughly representative and embodies the most notable names in the locality, with N. H. Hutton as consulting engineer and Lewis M. Haupt as engineer in charge of surveys.

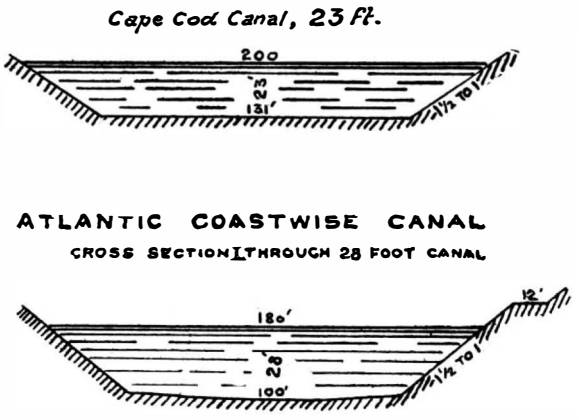
The Cape Cod Canal is less costly and of less magnitude, but scarcely of less importance than the above. It is proposed to cut through Cape Cod peninsula, entering at the mouth of Bass River and terminating in Barnstable Bay. The scheme would utilize the existing waterway known as Bass River, which has an average L. W. depth of 6 to 7 feet. This will necessitate 16 feet of dredging to secure the desired 23 feet depth of canal. The survey follows the river for 5½ miles, and then shows a cut through easy material for 2½ miles to tidewater in Barnstable Bay. There will be training walls at each outlet. The canal will be tidal; the 40 minutes difference in H. T. at each end creating a flow that will exert a beneficial scouring action on the channel.



THE ATLANTIC COASTWISE CANAL.

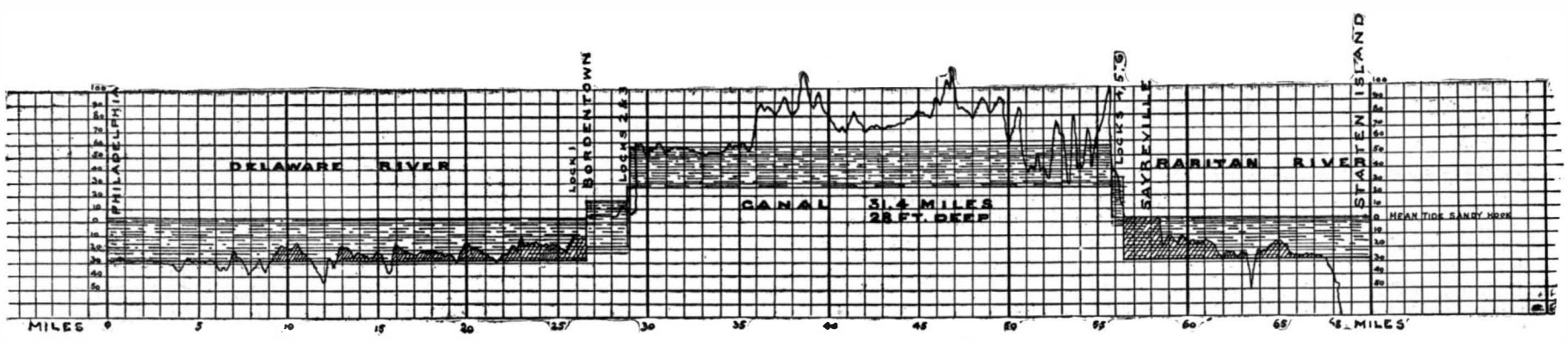
The cutting of the canal will shorten the journey from New York and the South to Boston by 184 miles, and it will enable shipping to avoid the dangerous shoals of Nantucket and the notoriously stormy weather off Cape Cod.

It is estimated that 50,000 vessels, averaging 500 tons each, go round the cape yearly. On the reasonable supposition that 60 per cent of this traffic would use the canal, there will be carried through the latter during the year over 12,000,000 tons. By charging less than one-half the present estimated cost of 25c. to 40c. per ton round the cape, or say only 10c. per ton, a revenue of $1,200,000 would be assured.



A strong and representative company, bearing the name of the Massachusetts Canal Company, has been formed for the prosecution of this work, with an authorized capital of $7,500,000 in shares and an equal amount in bonds. The details of the scheme are set forth in a voluminous report, which is enriched with several excellent half-tone prints showing the suitable topography of the route surveyed and adopted for the canal.

That these two schemes will prove financially profitable seems certain, for the reason that they merely present a swifter, safer and cheaper water route for an enormous water-borne traffic which already exists.



THE ATLANTIC COASTWISE CANAL.

Labor's Triumphs.

The Stone Trade News makes mention of what are considered as the ten most remarkable works of human labor:

1. The Pyramids of Egypt, the largest of which, near Cairo, known as the Great Pyramid, built by Cheops, King of Egypt, took 350,000 men twenty years to build.

2. The artificial reservoir—Lake Moeris—built by Amenemha of the twelfth dynasty, which served to store up the waters of the Nile during the season of floods, and distribute them by canals over the land during the dry season. Its circumference was 3,600 furlongs, and on its being allowed to fall into ruin, the fertility of the region became, to a serious extent, a thing of the past.

3. The Taj Mahal, a tomb erected at Agra, in Hindostan, by Shah Jehan, over his Queen, Noor Jehan. It is built of the purest white marble, and yet seems so airy that when seen from a distance, it is so like a fabric of mist and sunbeams, with its great dome soaring up, a silvery bubble about to burst in the sun, that even after you have touched it and climbed to its summit you almost doubt its reality. It cost over three million pounds.

4. The Temple of Baalbec, in the erection of which stones 62 feet long, 20 feet broad, and 15 feet thick have been used—more prodigious masses than have ever elsewhere been moved by human power, and much exceeding in size the stones used in the Pyramids.

5. The Temple of Karnak, described by Fergusson as the noblest work of architectural magnificence ever produced by the hand of man. It covers twice the area of St. Peter's at Rome, and undoubtedly is one of the finest buildings in the world.

6. The Great Wall of China, 1,230 miles in length. It is 20 feet in height, and in thickness 25 feet at the base and 15 feet at the top.

7. The Eiffel Tower, erected in the grounds of the 1889 Paris Exhibition, 984 feet high.

8. The Suez Canal, with 88 miles of waterway connecting the Mediterranean and Red Sea, and forming the principal route to India. It cost more than 17 millions sterling, and 172,602 out of the 399,677 shares were purchased by and belong to the British government.

9. The railway bridge (the largest cantilever bridge in the world) over the Forth, with two spans each of 1,700 feet, erected at a cost of nearly four millions.

10. The leaning Tower of Pisa, which deviates 13 feet from the perpendicular.

The following works were by the ancients esteemed the seven wonders of the world: The Pyramids; the Tomb of Mausoleus; the Temple of Diana; the Hanging Gardens of Babylon; the Colossus of Rhodes; the ivory and golden statue of Jupiter Olympus; and the Pharos or Watch Tower of Egypt.

India Rubber in Jamaica.

One result of the persistent efforts of those having in charge the Royal Botanic Garden, at Trinidad, to inaugurate the India rubber industry in Jamaica has been to establish the fact that a rubber-yielding plant likely to prove of value is indigenous to that island. It is the Forsteronia floribunda (Don.), known locally as the "milk withe." According to the Bulletin of the Botanical Department (Jamaica), this climber is found generally as thick as a man's wrist, and sometimes much thicker, and it reaches to the tops of the tallest trees, though often growing over rocks, fully exposed to the sun. The sap coagulates simply on exposure to a dry atmosphere.

JAPANESE workmen wear, both on their caps and on their backs, an inscription stating their business and the name of their employer.

NEARLY all the glass eyes used in the world are made in Thuringia, Germany.

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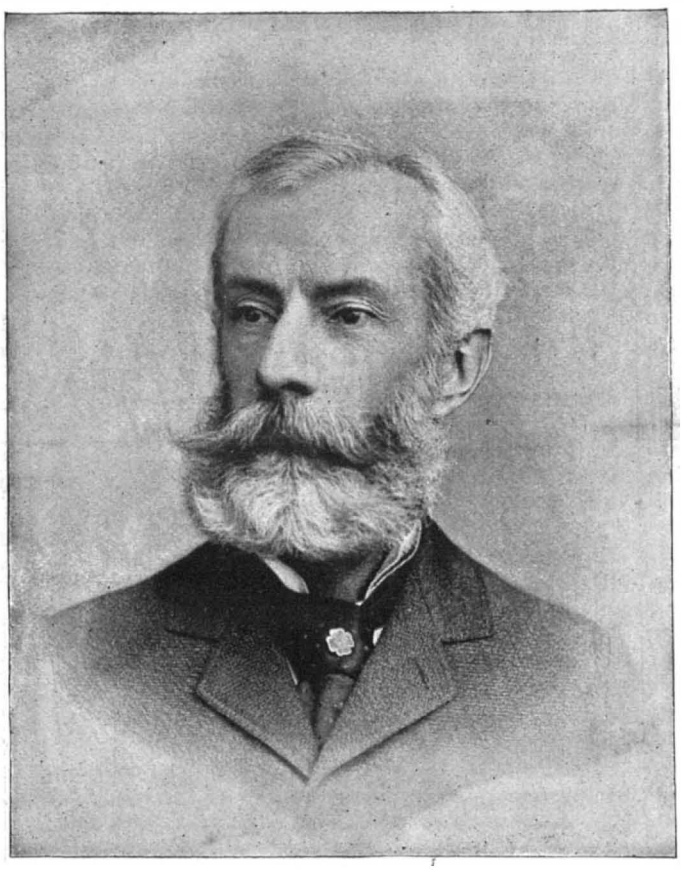
EDWARD C. F. DAVIS.

While riding horseback in Central Park, New York, on the evening of August 6, Mr. Edward C. F. Davis, president of the American Society of Mechanical Engineers, and manager of the C. W. Hunt Company iron works, was killed. For our illustration and the accompanying particulars we are indebted to the Railroad Gazette. Mr. Davis was born at Chestertown, Md., in 1847. He was educated at Washington College, Maryland, having been graduated in 1866. His parents intended him for the profession of law, but he had a strong natural preference for mechanical matters, and was so resolute in his determination to become an engineer that he finally secured the consent of his parents to his making an effort in that direction. He went to Philadelphia and entered the employ of Brinton & Henderson, hydraulic engineers, as an apprentice, where he learned the arts of machinist and draughtsman. At the end of his apprenticeship he was employed by Messrs. Hoy, Kennedy & Company, of Newcastle, Del., later of Brooklyn, N. Y. After several years with this firm he went as draughtsman with the Pottsville Iron and Steel Company, and later became draughtsman and assistant to Mr. S. D. Whiting, superintendent of the Colliery Iron Works, at Pottsville, Pa.

In 1878 Mr. Davis entered the service of the Philadelphia & Reading Coal and Iron Company as mechanical draughtsman. A year later, that is at the age of 32, he was made superintendent of the company's shops at Pottsville. These shops were then being established for building and repairing mining machinery. The work of organizing this establishment fell principally upon Mr. Davis. In 1887 he became mechanical engineer for the company, which position he resigned in 1890 to become general manager of the Richmond Locomotive and Machine Works. This position he gave up last spring to take the position which he held at the time of his death.

Mr. Davis was a man who had won the personal regard of a great many of the best mechanical engineers of the country and who had before him the promise of a very useful and influential future.



EDWARD C. F. DAVIS.

Science Notes.

New Metal for the Electric Industry. — It may be that before long, says the Etincelle Electrique, glucinium will come to assume a genuine importance in the electric industry. Of the atomic weight 9·1 and epiderfic weight 2, the resistance of traction of glucinium is no greater than that of iron, and its conductivity is equivalent to that of silver. This metal is therefore mechanically more resistant than iron, a better conductor than copper, and besides is lighter than aluminum. If all these data are verified by experiment, there is no doubt that glucinium will soon be employed in electricity, and the more so in that its market value will be about twenty dollars a pound, which is about one hundred and sixty times less than the same volume of platinum and ten times less than the same weight of the latter metal.

Is Oxygen a Simple Body?—Mr. E. C. C. Baly, preparator to Prof. Ramsay, of University College (London), has just presented to the Royal Society of London a preliminary note tending to establish the fact that oxygen is not a simple body, as has hitherto been thought, but an association of two distinct gases. The fact that he announces is this: If oxygen be submitted to a silent electric discharge, the gas that goes to the cathode, according to the experiment, while remaining oxygen, exhibits a density sensibly different from that of non-electrified oxygen. In the case of long sparks, the density is less. The opposite is the case when short sparks are made to act. Is this as much as to say that the ordinary density of oxygen represents simply the major part of the densities of the molecules of the gas, and that the silent discharge has the effect of sorting out such molecules in assembling those that are of the same weight?

Substitute for Guttapercha.—According to a French exchange, a substitute for guttapercha may be prepared as follows: Tar, 1 part; paraffine, 10 parts; dissolve together at 120° and then add caoutchouc, 2 parts. Keep at this temperature until a homogeneous mass results.

Grape Food.—On the western edge of the Santa Clara Valley, near Los Gatos, Cal., there is a factory in which white wine grapes are crushed and their juice formed into what is called "grape food," that is, the juice is concentrated without fermentation. Fifty tons of grapes are treated every day. The process of manufacture, according to a correspondent of Harper's Weekly, is as follows: A small, but constant, stream of fresh juice flows into the upper end of a copper cylinder 19 feet long and 2 feet in diameter and inclined at a slight angle. This cylinder revolves slowly in a hot water jacket kept at a temperature of 150 degrees F. The juice forms a film on the interior of the cylinder, the water evaporates from it under the heat, the vapor is drawn away by rapidly revolving exhaust fans, and the juice, which has taken but sixty seconds to pass through the cylinder, trickles from its lower end in a warm, sirupy stream, reduced to one-quarter of its original bulk, but retaining all its original elements except the water.

The Aging of Alcohol Artificially.—As the subject of alcohol is occupying a great deal of attention in France, owing to new measures being passed in the Senate for placing the manufacture under state control, a few remarks may not be out of place on the methods adopted by some firms for artificially aging alcohol, and notably brandy. The ordinary method of spraying the spirit into an atmosphere of oxygen, though improving it, without, however, giving it the qualities of age, has been greatly improved by Mr. Villon, whose process is as follows: The spirit is heated to a temperature of 70 degrees C. Oxygen is then pumped in at a pressure of from five to six atmospheres, and care is taken to maintain the pressure during twelve hours, the liquid being agitated from time to time. The spirit is then drawn off and allowed to rest for a week. The advantages of this method are that all traces of fusel oil are destroyed, without deteriorating the aroma of the spirit, at a trifling cost.

Gelsoline.—Speaking of gelsoline, the new fabric or material prepared from the fiber of the bark of the mulberry tree, an exchange remarks upon the singular fact of the existence of three absolutely distinct fibers obtainable from or peculiar to this tree. Thus, in addition to the ordinary silk, a strong and thick fiber for certain purposes may be obtained by killing the silk worm and drawing the thread from its interior. In the preparation of gelsoline, the bark is retted and the fiber treated after the manner of flax, and, after purification with soap and soda, is ready for the weaving shed. Some works in Italy, it appears, are already producing thousands of yards of the woven fabric for upholstery purposes. This new material is said to be ten times as strong as middling Orleans cotton, and to be obtainable at one-tenth the price of flax. Being perfectly round, the fiber insures a close fabric.

The Discharge of Electric Fishes.—Mr. D'Arsonval has studied the electric discharge of the torpedo for the purpose of determining the intensity of the discharge current and the electromotive force brought into play. He recalls that Mr. Marey has demonstrated that it is a question of a discontinuous phenomenon, and that we are in the presence of a series of discharges. In order to measure the intensity, Mr. D'Arsonval employed a special galvanometer based upon the principle of the galvanometer that he devised in conjunction with Mr. Marey, that is the mobility of a helix traversed by a current in a magnetic field of great intensity. This discharge is very powerful. Thus a torpedo 12 inches in diameter, excited by a pinching of the fin, gives an electric discharge of an intensity of 8 amperes and an electromotive force of 12 volts, which is capable of lighting incandescent lamps and of producing 6 inch sparks in an induction coil. But the discharges continue to decrease. They are from 4 to 15 in number, and succeed each other at intervals of a hundredth of a second, so that the total duration of the phenomenon is about a tenth of a second. The electromotive force may reach 20 volts. In a second series of experiments, Mr. D'Arsonval isolated the organ that generates electricity and excited the nerves by electricity. In this case, but a single shock is observed. The internal resistance of the organ varies from 1·8 to 2·5 ohms. It increases after the discharge.

The Rays of the Solar Spectrum.—The fact is well known that if we examine the spectra furnished by the light emitted by the various points of the sun, the rays that appear are very variable in number. There exist but eleven that are constant, that is to say, that we find in the light derived from all the regions. Among these, five belong to hydrogen, two to calcium, and four to unknown elements. Mr. Ramsay, however, has identified one of these rays, that of helium, with the ray of a terrestrial element. There remained then but three, corresponding to extra-terrestrial substances. Mr. Deslandres has decomposed clevite by sulphuric acid, and then, on studying the spectrum of the gas disengaged, has ascertained the existence of a ray 447·18 identifiable with one of the three remaining rays. In consequence of this discovery there exist but two unknown rays among the permanent ones of the spectrum.

Direct Puddling of Iron.—A new installation for the direct puddling of iron has recently been created at the Bonehill establishment at Hourpes, near Charleroi, Belgium. The iron, on coming from the furnace, flows into a reservoir of about 30 tons capacity, heated by gas, whence it is transferred, by means of a pocket mounted upon a small car, to the puddling furnaces. According to the Revue Industrielle de Charleroi, the operation of puddling lasts but 40 or 45 minutes; and a gasogen furnace attended by four men produces 12,000 pounds of iron of excellent quality in twelve hours, with a total consumption of 2,200 pounds of coal. The waste is but 7 per cent.

A New Explosive.—Prof. Victor Meyer has obtained an isolated derivative of nitromethane, the detonating power of which seems to exceed anything that has ever hitherto been conceived of. This derivative results from the substitution of one atom of sodium for one of the three atoms of the hydrogen of the methane. In order to prepare it, Prof. Meyer dilutes a certain quantity of nitromethane with sulphuric ether and then adds, in alcoholic solution, the body resulting from the action of the sodium upon the alcohol. The precipitate formed is washed with ether and then dried by means of concentrated sulphuric acid. The compound is anhydrous and its explosive force is terrific. The potassic derivative of the nithomethane is likewise possessed of explosive qualities of extreme energy. It is prepared in the same way as the sodic derivative.

Solders for Glass.—Mr. Chas. Margot finds that an alloy composed of 95 parts of tin and 5 of zinc melts at 200 degrees, and becomes firmly adherent to glass, and, moreover, is unalterable and possesses a beautiful metallic luster; and, further, that an alloy composed of 90 parts of tin and 10 of aluminum melts at 390 degrees, becomes strongly soldered to glass and is possessed of a very stable brilliancy. With these two alloys it is possible to solder glass as easily as it is to solder two pieces of metal. It is possible to operate in two different manners. The two pieces of glass to be soldered can either be heated in a furnace and their surface be rubbed with a rod of the solder, when the alloy as it flows can be evenly distributed with a tampon of paper or a strip of aluminum, or an ordinary soldering iron can be used for melting the solder. In either case, it only remains to unite the two pieces of glass and press them strongly against each other and allow them to cool slowly.

Massachusetts Street Cars Must Have Fenders.

After November 14 next, according to an order recently issued by the Railroad Commissioners of Massachusetts, the cars of every street railway in the State must be equipped with fenders and wheel guards capable of saving life. Horse cars and trailers are excepted, and a temporary exception is made of cars run wholly within the limits of towns having a population of less than 7,500. No special form of fender is indicated, but when the fender is designed to serve also as a wheel guard, it must not only pick up a person run into while standing, but prevent a person who has fallen or been thrown down from getting under the car and being run over by the wheels. The commissioners say, "No one form of fender or wheel guard has as yet been proved to be so unquestionably superior to all others, tried and untried, as to justify the prescription of its sole and its exclusive use;" and the several street railway companies are therefore left free to deal with patentees and inventors, for the selection of such fenders as will in practice prove most efficient.

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THE BOSTON SUBWAY.

Some years ago the street car system of the city of Boston was converted, practically in its entirety, into a trolley system, and now the city is traversed in all directions by electric cars. One of the most striking scenes in the city can e witnessed in the mornings and evenings of business days, when a stream of pedestrians in one or the other direction, according to whether it is morning or evening, cross the Common obliquely, while around the Boylston and Tremont Street corner run numerous trolley cars of various lines, crowded with passengers, car almost touching car. This is noticeable especially between the corner mentioned and Park Street, where on two tracks are accommodated, or rather not accommodated, a number of different lines of cars. Tremont Street, narrow at the best, is also crowded with vehicles, so that the condition of transportation there is exceedingly unsatisfactory. Work is now in progress, as illustrated on our first page, on a subway, or underground road, which is designed to do away with this congestion, and which it is believed will take care of the traffic adequately. The idea is that by having a tunnel devoted to the railroad alone, and free from all interference of vehicles or pedestrians, schedule time will be made by the cars, which can naturally be run at much higher speed than on a crowded street. One of our views represents the crowded condition of Tremont Street, near the old Park Street church, during the busy hours in the morning and afternoon. Another view shows the manner of construction of one of the inclines, while the other shows the details of the four-track subway throughout its course, which is not always directly on the center line of the street.

The general course of the subway is shown in the map. Its southern end has two approaches, one from Boylston Street, beginning on the margin of the Public Garden, crossing Charles Street below the street level and running underground beneath the edge of the Common toward Tremont Street. Further south on Tremont Street, and near Common Street, is another incline marking the other entrance, from which incline a two-track subway runs to the corner of Boylston Street, meeting the Boylston Street line. Here the main subway is reached, a four-track tunnel running along the edge of Boston Common from Boylston Street to Park Street. At Park Street there is a loop, by which a portion of the cars can be returned on their course without the motorman changing his platform. From the Park Street corner a two-track tunnel continues to Brattle Square where the two tracks diverge into four tracks, two in the Brattle Street subway and two in the Cornhill Street subway, which subways join into one beneath Washington Street and thence run into the Union Depot. Just before the Union Depot is reached there is an incline by which two of the tracks reach the surface, while the other two are united by loops for the return of the cars. These two loops are for the return of cars going toward the Union Depot. The triangular junction in Brattle Square provides a loop for the return of cars going in the opposite direction, toward Tremont Street. These three loops increase the facility of operation of the system immensely and are one of its most characteristic features.

There are five stations in the subway. One is on the corner of Boylston and Tremont Streets; the next is at Tremont and Park Streets, at the corner opposite the famous old Park Street church; the next is in Brattle Square; the next is near Haymarket Square, and the terminal station is in Canal Street, opposite the Union Depot. From one of our views the reader may obtain a good idea of one of these subway stations and the ample facilities they will afford for the entrance and exit of passengers.

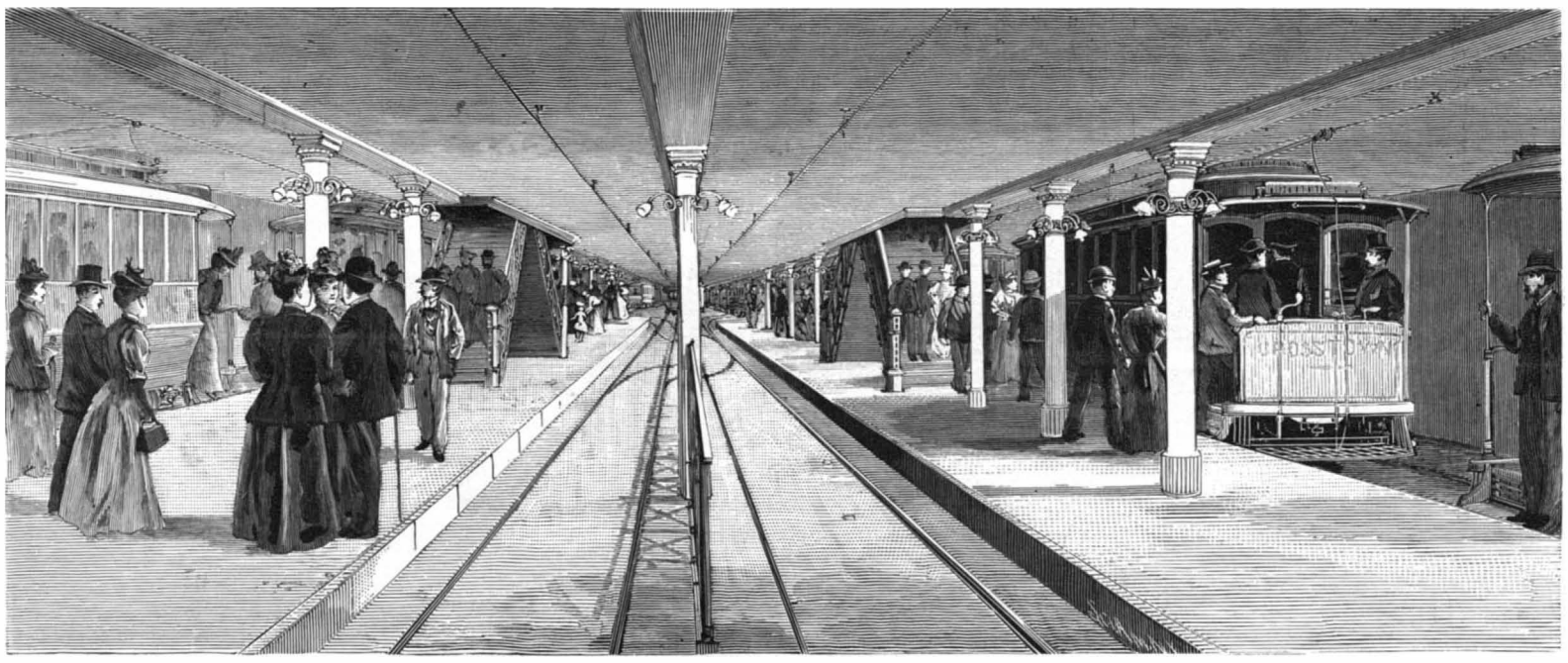
The general character of the subway differs from the type of tunnel hitherto employed for such structures. It is an object to have it near the surface and to have it independent of lateral ground support, in the sense that it can stand by itself, if earth is removed from about it. This makes it secure from disturbance by excavations in the street. Hence, for the top, steel beams, with brick or concrete arches turned between them, are employed. For its bottom, two invert arches of brick or concrete are to be used, the side walls rising from which are of masonry. A central row of pillars supporting a longitudinal girder is provided to support the center of the roof in the four-track structure. The entire structure is to be made as waterproof as possible, and electric pumps are to be installed for the drainage of water that may collect in the sumps. Its standard height is 14 feet; its standard width for two tracks is 24 feet, and for four tracks 48 feet. This will bring the top of the rail 17 feet below the surface of the street level, giving a descent of 16 feet for the passenger—a descent less than the average ascent required by the New York Elevated Railway system.

As tracks have to cross each other in the subway in two of the stations, and as it was felt that in executing a permanent work of this character anything equivalent to a grade crossing should be excluded, the necessary crossings are to be managed by sinking one track beneath the other, so that at two of the stations are to be established what are termed "undercrossings" or "sub-subway tracks."

The sides of the structure are laid in a series of arches with vertical axes each of six feet chord. They are concave inward, the intrados facing the tunnel axis. At each springing line a steel column, a 15 inch I beam, is bedded in the masonry, its base resting on an abutment three feet wide. The roof beams, 20 inch I beams, weighing eighty pounds to the foot, are spaced three feet apart and the versed sine of the arches sprung between them is nine inches. Diagonal struts run across the upper corners between the uprights and every second horizontal beam. Diagonal trussing is also applied between the central columns in the four-track structure at intervals.

The entire operations are in the hands of the Boston Transit Commission, with the following membership: George G. Crocker, chairman; Charles H. Dalton, Thomas J. Gargan, George F. Swain, Albert C. Burrage, commissioners; B. Leighton Beal, secretary; Howard A. Carson, chief engineer.

Our thanks are due to Mr. Howard A. Carson for information furnished.



THE BOSTON STREET CAR SUBWAY—ONE OF THE STATIONS.

How Butter Dishes and Clothespins are Made.

The oval, scooped-out disks of wood which have become so familiar at the grocery for doing up butter, lard and other commodities, and at the Sunday school picnic as a receptacle for pie and pickles, are manufactured in Traverse City, Mich., and the factory turning them out is the largest in the world; in fact, says the Chicago Record, it is said to be the only one except a factory in St. Louis, which operates under the patents owned by the Michigan company. The company buys the standing timber on a tract of land and works up everything on it, whether elm, ash, maple, birch or hemlock. The factory consumes about 12,000,000 feet of lumber annually.

The logs as they are cut in the forest are floated down the Boardman River to the mill booms, and as they are wanted are hoisted into the sawmill, where they are cut. For the butter dishes maple is the only wood used. The outer slabs of the maple logs are slashed off and cut to dimensions of firewood. Then a few layers are sliced off for lumber. After the slabs and lumber are cut a piece of timber about six inches in thickness and eight inches wide is left the length of the log, and this is the part reserved for the butter dishes.

The heavy timber is cut into blocks ten or twelve inches in length and boiled in huge vats until thoroughly softened. The hot blocks are placed in machines which scoop out the butter dishes at the rate of two hundred a minute. A curved knife revolving on a spindle does the work, the block being automatically advanced with each revolution of the spindle, and a knife working up and down taking off a slice just the thickness of the plate, so as to leave the surface the same as before. The dishes are scooped out of the solid wood exactly as they are found at the grocery, and all that is done to them after they leave the machine is to dry and pack them.

As the dishes fall from the machine they drop into a funnel which carries them to the dry kilns. Through the drying process they pass automatically and finally fall upon a long table, where a row of girls sort them and prepare them for packing. It takes about twenty minutes for the plates to go through the drying process, and not a hand touches them until the girls sort them for packing. Ten machines are working constantly on the oval butter dishes, and the capacity of the works is approximately six hundred thousand a day.

The most wonderful machine in the shop is that which manufactures the wire-end dishes. For these the logs are cut into bolts, boiled, and then converted into veneers the thickness of the materials used in the plates. Still hot and steaming the veneers are fed through a machine which cuts the veneer to the required shape and size, marks the folds, folds them, and sews the ends of the dish with wire, and finally delivers the dish complete at the other end. These machines turn out the wire-end dishes at the rate of one hundred a minute, and the factory facilities are for two hundred thousand a day when running at full capacity.

In making clothespins, cull lumber which cannot be used for dishes and is not suitable for high grade lumber is used. The lumber, as it comes from the saw, is cut into lengths. These blocks of wood are carried to a receptacle above and rapidly fed down upon a table where a nimble-fingered girl arranges them sidewise upon a revolving metal belt. The belt carries them to the turning machine, where the blocks are cut into the shape of clothespins without the forks. As the turned blocks drop down, another girl arranges them upon another belt which carries them to the saw which forks the pins and gives them the inner bevel on the ends. From this machine the pins drop into a carrier which takes them to the big revolving cylinders where they are dried and polished, the cylinders receiving and delivering the pins automatically.

The wooden washboards are made of thin maple boards, which can be used neither for dishes, clothespins nor lumber. The boards are given the "crimp" so familiar in washboards by a machine which works all but automatically, and the side pieces and headboard are dovetailed in the same way. One man puts the boards together, aided by a machine, and he turns out about forty dozen washboards daily. The wooden boards are sold almost entirely in the South.—Boston Jour. Com.

ON a rough average, 45,000 sovereigns pass over the Bank of England counters every day.

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THE NINTH INTERNATIONAL YACHT RACE.

It was in the year 1851 that the schooner America met and defeated a whole fleet of British yachts, big and little, and brought back the silver trophy toward which English yachtsmen have looked ever since with covetous eyes; for the possession of which they have contended with a pluck and persistence characteristic of the race. Eight times have they braved the dangers of the Atlantic passage, and eight times have they met with a crushing defeat. In the present issue we present our readers with views of the ninth international challenger, Valkyrie III, and of the probable champion that will oppose her, very aptly named Defender.

In all previous cup contests there has been prevalent among American yachtsmen a sense of security in anticipation of the approaching struggle which the event has fully justified. In the present instance, however, the confidence is not so marked or widespread; for, while it is true that the majority of patriotic Americans are confident in the ability of the Herreshoff creation of 1895 to accomplish its work as neatly as did their 1893 production, there are others (and they are chiefly to be found among the yachting experts) who are doubtful as to the result. This latter sentiment should win cups in English waters, and then come over here and win the America cup off Sandy Hook.

The experience gained with Valkyrie II proved the hopelessness of such an attempt. There is a weight and vim in the winds that blow around the English coast which necessitates a snug sail plan, if that sail is to be carried in all weathers. The prevalent winds off Sandy Hook, in the fall of the year, are relatively much lighter, and permit a much larger sail spread to be carried. This year Lord Dunraven has given it out that the Valkyrie is designed specially for Sandy Hook courses; that is to say, that she is an ideal light-weather boat.

Any one who takes note of her great beam, shallow under-water body, and her immense spar plan, must admit that Designer Watson may have reached this ideal. She should be a very fleet boat in light winds.

But what if it should come on to blow? Well, that contingency is simply unprovided for. Her record, brief as it is, proves this beyond a doubt. In her maiden race against Britannia, sailed in a light wind, she drew rapidly ahead from the very start, "and never stopped going until she was thirty-six minutes ahead by the clock, and about six miles in distance." Later she ran into a calm, and finished only slightly

In our own Defender, on the other hand, we have probably a better all round boat than Valkyrie; though judged by her performances against Vigilant, and Valkyrie's against Britannia, in light weather Valkyrie would certainly appear to be the faster boat. Nor must we make too much of the reputed increase in Vigilant's speed; for it is certain that the increased sail-spread that was given Britannia this season has made her a faster boat than last year, when she met Vigilant.

Should the breezes be strong however, and should there be a short, lumpy sea running on the day of the races, for our own part we should not be surprised to see Defender cross the line fully 10 minutes ahead of her huge antagonist.

In construction the two boats are marvels of lightness. The Defender is built of steel framing with manganese bronze plating below the water line and aluminum bronze from the water line up. Her deck beams are alternately of aluminum and steel. The use of aluminum reduces her top weight and gives her, as compared with the heavier construction of the Valkyrie, a lower center of gravity and a proportionately greater sail-carrying power. Her rigging, spars, etc., are remarkably light, perhaps excessively so; though

THE BRITISH YACHT VALKYRIE III.

has been strengthened since the visitor was docked and has had an opportunity to show her abnormal power of hull and the enormous sail spread that she carries above it.

There are certain factors in the situation that render the issue more doubtful than in former years, and that make the challenger's prospect of winning more possible. In the first place, in previous contests, the English boat has been built and launched early in the year. She has sailed in many regattas; and her size, sail spread, best points of sailing, and a hundred and one other points of interest, have been in the possession of the home designer, as he sat down at his desk to draught out the lines of a boat that should beat her. This year the boats were built simultaneously, and there was no such information to hand. To our surprise we find that the tables are turned—we have to fight a boat much bigger than our own. Unlike the previous English boats, she is an unknown quantity. She sailed four races on the other side; and lo! before her sails are fully stretched, she unbends them, and goes to the yard to be rigged for her ocean voyage.

This would seem to show that her performance was fully up to the expectations of her designer, Mr. Watson, and of her owners, the Dunraven syndicate.

In former contests, moreover, the English have made the palpable mistake of trying to design a yacht that ahead of Britannia. She sailed her next race against Ailsa, a new ninety-foot boat. The course was seven and one-half miles to windward and return. It was sailed in a light breeze, and Valkyrie won by fifteen minutes. In another fifty-mile race she beat Britannia by nineteen and one-half minutes. The wind was fresh, and she averaged eight and one-half knots over the course. The yachting experts claimed that, had the wind been lighter, she would probably have beaten Britannia by twice as much. These races were sailed in the weather for which she was designed, and they are certainly creditable performances. There was another fity-mile race, however, in which she was thoroughly well beaten. It was sailed in a strong breeze, and Valkyrie appeared unable to carry her sail. She dropped slowly astern, and finished three minutes behind Britannia. She made a very poor showing, staggering along on her beam ends in a smother of foam, with the water half way up her deck, and a huge bow wave roaring away to leeward. She showed how little she was designed for hard driving in a strong wind. Britannia meanwhile, be it said, was standing up like the proverbial church. For such weather she is clearly over-sparred.

These trials, such as they are, would seem to show that Valkyrie will be a very dangerous competitor in light breezes, and a very harmless one in a blow.

the cutter is now at Bristol for the purpose of having her gear overhauled and strengthened. She has moderate beam, remarkably fine lines, a fairly full under-water body for an American yacht, and abnormal draught, at least five more than the defender of 1893.

The Valkyrie is of what is known as composite construction—elm planking on nickel-steel frames. She is not coppered, except on her lead keel; but is painted with a patent enamel, which is said to give a remarkably smooth surface. She is more stoutly rigged than the Defender, and is every way a heavier boat.

Probably about 55 per cent of the displacement of the Defender is in her lead keel; for Valkyrie the ratio will be about 50 per cent.

It will be seen, from the above facts, that there is much about the coming struggle to make it especially exciting. It promises to be more evenly contested than any previous series of races.

The winner of three races out of five will take the cup. The first race, which takes place on September 7, will probably be 15 miles to windward and return. This will be followed by a triangular race of 10 miles to the leg; the third race being over the windward and leeward course.

FORTY to fifty miles a day is about the maximum distance attained by ordinary riders on a tricycle.

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Habits of Spiders.

BY J. BEECHAM MAYOR, L.R.C.P., M.R.C.S.

Dr. W. H. Dallinger has recently written a paper dealing with the constructive ingenuity of spiders, from which we may conclude that they not only inherit, but also acquire, useful and beneficial habits, or modify those inherited. For instance, the triangle spider (Hyptiotes cavatus), of America, so called from constructing a web that is only a segment of a circle, makes the web not only a snare but also a gin, i. e., a stratagem or contrivance closing suddenly upon the snared victim. When, from position or other circumstances, it has been found necessary to keep the web constantly extended and drawn taut, it is often found that the circular web spiders will attach a weight to the end of a line connected by cords with the framework of the whole of the web. An instance of this adaptation to environment has recently come under my notice. A lead water supply pipe runs along the ceiling of a cellar, and from it depended a piece of twisted string, about eight inches in length. The end of this string was drawn upward by the spider with a strong silken strand attached to the ceiling some little distance away from the leaden pipe, so that the string formed a perfect curve. In the space thus bounded by the ceiling, the string and the silken strand, joining the two latter, a perfect circular web had been constructed by the ingenious spider, the string acting as a weight or counterpoise to keep the web firmly stretched, as well as forming a necessary boundary to it for the attachment of strands.

Purification of Petroleum.

It is known that in washing petroleum distillates with sulphuric acid the concentration and purity of the acid have an important effect on the quality of the refined product, but the question of temperature, which the author considers of equal moment, does not appear to have received proper attention on the part of chemists.

The best results are invariably obtained by conducting the acid washing process at as low a temperature as possible. The author worked at temperatures ranging from 0° to 25°, and obtained whiter and purer products the more closely he approached the lower limit. Working under identical conditions as to concentration and purity of acid, the distillate obtained after the acid treatment at 25° had a distinct yellow color, while that following an acid treatment at 0° was almost colorless, with simultaneous diminution of the difficulties accompanying the process of purification, i. e., at the lower temperature the rate of clarification increased with the yield of refined product.

The action of sulphuric acid on petroleum is of twofold character: (1.) Elimination and solution of impurities. (2.) Oxidation of the heavier portions. Although the rate of absorption is not materially influenced by slight variations of temperature, the oxidation increases rapidly with a rise of temperature, as is evinced by the copious evolution of sulphurous anhydride. Moreover, at a higher temperature, the solvent properties of petroleum for resin acids, and more especially for oxidation products, increases, the result being the contamination of the distillate with impurities, which it is impossible to completely remove either by washing with soda lye and water or by other means.—R. Zaloziecki, Chem. Zeit.

WHILE there are no complete statistics available, careful estimates from all possible sources of information make it probable that at the time of the discovery, there were not more than 500,000 Indians in all North America.

The Cause of Porous Rubber Tires.

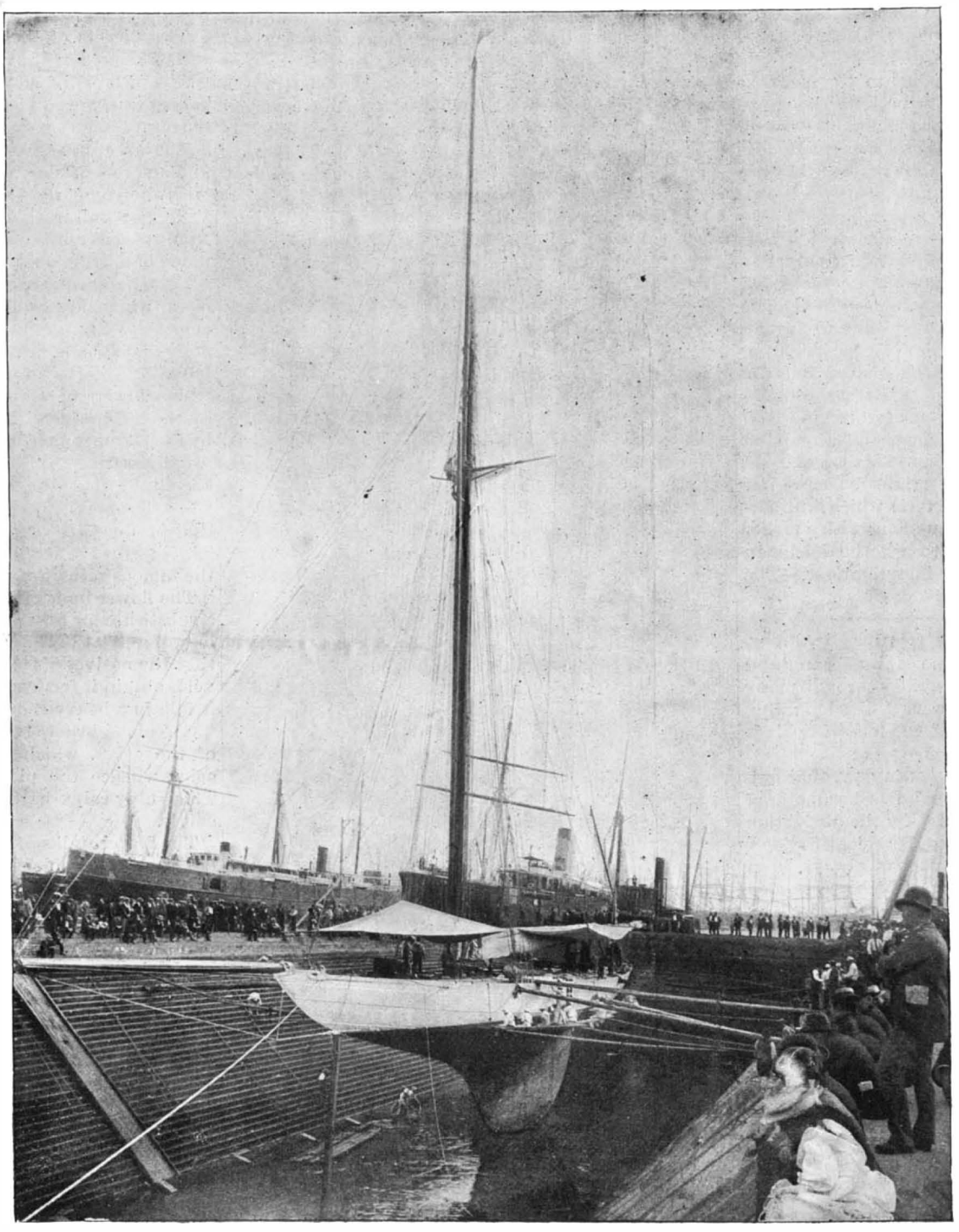
A writer in the India Rubber World, who styles himself a rubber manufacturer, says: "There is no one part of a bicycle so important as the tire, and no one part so little understood by the rider, and, in fact, by most of the bicycle manufacturers who use them.

"Most people imagine that the making of a pneumatic tire is a very simple operation. They liken it to a garden hose and fancy it a mere trifle, but there is nothing more difficult nor anything in the rubber goods line that requires more care in manufacture than a single-tube tire. We make both single and double tubes, and have sold far more of the former than of the latter. We give our patrons exactly what they call for, and are not prejudiced in one way or the other. I simply know that the volume of single-tube tires that are returned to not only ourselves, but, to my certain knowledge, to every other manufacturer, is amazing. No; the making of a double-tube tire is not so difficult. You can see what you are doing. With the single tube it is different.

"The cause of the trouble? The inability to locate the source of a puncture or leak. We can, of course, make a tire that is fairly safe, but from the very nature of things it must be heavy and dead. You may take it for granted that in every case a lively, resilient tire is easily—too easily—punctured. It cannot be otherwise. Riders must choose between the two. One reason why a puncture in the single tube is so hard to locate—impossible, in many instances—is that the puncture has gone not only through the thread of the tire, but has minutely pierced or pricked the inside of the part next the rim. Few riders realize this. In fact, from the number of tires returned it seems as if none of them do. But, perhaps, they are not to blame. When such a puncture occurs every rider and every agent immediately apparently concludes that the tire is 'porous.' They have all caught on to that term. The tires are shipped back to the makers, and it cannot be denied that they, too, are often nonplussed. The puncture not having gone clear through, but merely pricked the inner coating, when the tire is placed in water a splendid aquatic display ensues. The air oozes through and in and around the threads of the fabric, and usually finds a dozen or more outlets, not one of which may be near the true source of the trouble, which is, of course, inside and invisible. Frequently it causes little pimples or blisters, and though one may insert plugs wherever one appears or wherever the water bubbles, it does no good. The tire still leaks. We have often inserted twenty plugs in a single tire and then had to give up the chase, for it really amounts to that.

"What causes a porous tire? Oh! there are any number of causes. We once had a spell of that sort of trouble with our inner tubes, and were at our wits' end to find the reason. We finally located it. Workmen walking on the floor above shook from the ceiling into the rubber composition fine particles of dust and wood. Another time we found that in the absence of the foreman some of the men had been skylarking—throwing at each other rags or something of the sort, which had been lying on the floor, and which contained fine particles. These got into the rubber, and a big batch of porous tires resulted. A mere speck on the mandrel or pole on which the tires are formed will also cause expensive mischief of the same sort."

The editor of the India Rubber World comments as follows: "As a matter of fact, the problem of avoiding porosity is one that has caused the rubber trade a deal of trouble and cost much money. There are times, of course, when particles of dust dropping upon sheets of thin rubber will cause porosity, but, as a rule, this is far from being the cause. A more common one is the presence of gas developed in the compound during vulcanization. For example, if the fabric upon which the compound is to be spread, or if the compounds themselves are damp, when heat is applied that dampness will become steam and will form little bubbles in the rubber, thereby causing porous places. Further than this, certain of the poorer grades of rubber contain ingredients that under heat resolve themselves into gases that do exactly the same thing. Then, too, in compounding, it oftentimes happens that two or more ingredients that are brought together will form a gas that results in the worst sort of porosity. For these reasons, rubber, adulterants, and fabrics should all be very carefully dried. After the compound has been spread on the calender, it is also an excellent plan to let it lie on the rack from twelve to twenty-four hours before using, which will oftentimes entirely do away with a tendency toward porosity. Rubber manufacturers who employ chemists can very easily tell whether their compounds are such that will develop gases during vulcanization, and should be able to avoid porous goods. A very good common cure for compounds that have a tendency to blister is to add a little slaked lime, which has long been known as preventive for this sort of trouble."



THE AMERICAN YACHT DEFENDER.

An African Gum.

This gum differs from tragacanth in being completely vitreous in appearance. It occurs in large pieces which are more or less elongated, but never rolled. When heated with water it forms a starch which separates in opalescent masses, and only dissolves on very prolonged boiling. Its solution is dextro-rotary and is precipitated by basic lead acetate, alcohol, and ammonium sulphate. With nitric acid the gum gives muric and oxalic acids, with sulphuric acid it yields furfurol. Potash colors it yellow, phloroglucinol and hydrochloric acid, or pyrogallic acid, pale red, but phenol and α-naphthol do not cause coloration. The gum appears to be formed under the bark.—C. Hartwich.

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Bacteria in Eggs.

It has been reserved for Dr. McClintock, of the University of Michigan, to point out that not even that dainty adjunct to the breakfast table—the egg—is free from the ravages of the "ubiquitous microbe." Hitherto this article has been consumed in happy ignorance, but the result of Dr. McClintock's investigation will be to seriously interfere with the peace of mind of many. In an evil moment the doctor took up the task of ascertaining whether eggs were infected with bacteria, and, if so, whether before they were laid or not. A healthy laying hen was obtained, and after repeated washings in a sublimate solution, she was placed in a sterilized cage. The hen laid regularly every other day, and the eggs were obtained as soon as possible after being laid and some of them wrapped in sterilized cotton and placed in an incubator. All these eggs became decomposed and swarmed with bacteria. Other eggs taken from the hen as soon as laid were broken and cultures made from their contents. Some of these culture tubes developed; others remained sterile. Some days after the hen was killed, and with due precautions, culture tubes were inoculated from various portions of the oviduct. Most of these tubes developed.

The evidence here seems to point to the fact that the egg was inoculated during its passage down the oviduct before the shell was formed. It does not, of course, follow that all eggs contain microbes, nor does it follow that even where bacteria are present they are in any way harmful. It is a matter of common knowledge that eggs kept excluded from the air will keep almost indefinitely. It is, moreover, difficult to understand how the experimenter succeeded in completely sterilizing his hen and her cage, and, if he succeeded in that temporarily, in keeping her sterile. The feathers of the bird, especially when shut up, would offer the more favorable medium for propagating bacteria, and it is quite possible that hence came the microbes. But, after all is said, what we want to know is the utility of information of this kind? If Dr. McClintock had boiled his eggs, and after that found in them the germs of some specific disease, such as typhoid or diphtheria, there might be cause for trouble; but, if there are any bacteria which will survive a few minutes in a frying pan along with a rasher of bacon, we would feel inclined to ask the Michigan professor to proceed with his investigations.—The Chemist and Druggist.

Pleasant Words from an Appreciative Neighbor.

Our esteemed contemporary, the Manufacturer and Builder, which has with marked ability through many years catered to the wants of a most discriminating class of readers, is pleased to make the following kindly commendatory remarks upon our work:

"The career of the SCIENTIFIC AMERICAN, that universally known and popular journal, has been one of remarkable success. It may now claim the distinction of being the oldest among the popular scientific journals of the United States, and it has always been among the best. The SUPPLEMENT, which was started in the Centennial year, has come to be recognized by all who are interested in the progress of science as the best source of general information, respecting the current of scientific thought, to be found in any language. It is almost exclusively eclectic in its make-up, but its selections are made with such intelligent discrimination that every field is culled of its best fruits. The ARCHITECTS' AND BUILDERS' edition of the SCIENTIFIC AMERICAN is of more recent origin, but fulfills its mission so well that it ranks with the best—as it certainly is one of the most useful—of American technical journals.

"Of the miscellaneous publications of Munn & Company, the 'Scientific American Cyclopedia of Receipts, Notes and Queries,' a large quarto volume of over 700 pages, is perhaps the most notable. It is a valuable work of reference on all subjects relating to the arts and industries, containing 12,500 receipts carefully collated from the latest and most trustworthy sources. Another admirable, practical work, especially praiseworthy for the excellence and wealth of its illustrations, is 'Experimental Science,' edited by G. M. Hopkins. As a hand-book for the study of natural philosophy it is unsurpassable. Without dwelling upon a number of miscellaneous technical works, all characterized by their practical treatment of the subjects to which they relate, we may refer finally to the 'Scientific American Hand-book,' an attractive little pamphlet, giving in concise form a large amount of important information respecting patents, caveats, trade-marks, etc., which every inventor will find highly useful to know. The great experience and extensive business of the firm of Munn & Company in this branch of professional work has made their name more widely known throughout the country, as well as in Europe, than that of any other American house."

THE President of the French Republic has a salary of £24,000 a year, and a further allowance of an equal amount of expenses.

AN IMPROVED HARP.

In the accompanying illustration is represented a harp in which are embodied late devices designed to improve the instrument in every way and to greatly enhance the quality and quantity of the tone, especially in the lower register. For these improvements a patent was recently issued, and they have been incorporated in the really superb instruments known as the Lyon & Healy Harps, built by the firm of that name in Chicago. As harps have been ordinarily built heretofore, the upper end of the sound board is of a width equal to the length of the string at that point, say three inches, while its lower end is less than one-fourth the length of the string, or is only about fourteen inches wide for a string about five feet long. To widen the base of the body of the harp and spread the pedals is impracticable, and has obvious objections in considerations of convenience and appearance. But by a combination with the body of side extensions, and a sound board secured thereto near their outer edges, with most skillful mechanical construction, the width of the sound board in the lower register is increased without increasing the width of the body, whereby the power, clearness, and beauty of the lower notes is greatly increased, so much so that they can be readily distinguished in full orchestra passages. Eminent virtuosi upon the harp have passed high encomiums upon the Lyon & Healy harps, and the new harp catalogue issued by the manufacturers contains portraits and the strongest kind of testimonials from such world famous artists as Aptommas of London; Cheshire of New York; Cervantes of Constantinople; Bressler of Paris; Possé of Berlin; Breitschuck of New York; Snoer of Leipzig; Bauer-Ziech of Dresden; Schuecker of Boston and others.

THE LYON & HEALY HARP, WITH ENLARGED SOUNDING BOARD.

Flowers as Food.

Although it is well known that many kinds of flowers are used in medicine, the fact may not be known to many that the blossoms of certain plants are employed as articles of food. In many parts of India the flowers of a sapotaceous tree, Bassia latifolia or mahwah, form a really important article of food. These blossoms, which are succulent and very numerous, fall at night in large quantities from the tree, and are gathered early in the morning and eaten raw. They have a sweet but sickly taste and odor. They are likewise dried in the sun and sold in the bazars. The Bheels dry them and store them as a staple article of food, and so important are they considered for this purpose that when in expeditions for the punishment or subjection of these tribes, when unruly, a threat is made by the invading force to cut down their Bassia trees, the menace most commonly insures their submission.

An ardent spirit like whisky is distilled from these flowers, and is consumed in large quantities by the natives of Guzerat, etc. The Parsees and hill people eat the flowers both raw and cooked, often with the addition of grain, and also make sweetmeats of them. A single tree will afford from two to four hundred pounds of the flowers.

The blossoms of another species, B. longifolia, are employed in a similar manner by the natives of Malabar and Mysore, where it abounds. They are either dried and roasted and then eaten or are bruised and boiled to a jelly and made into small balls, which are sold or exchanged for fish, rice and various sorts of small grain.

The flowers of the Judas tree, Cercis Siliquastrum, of Europe, have an agreeable acid taste and are sometimes mixed with salads or made into fritters with batter, and the flower buds are pickled in vinegar. The flowers of the American species, C. Canadensis, the red bud, are used by the French Canadians in salads and pickles.

The flowers of the Abutilon esculentum, bençao de deos, are used in Brazil as a boiled vegetable.

The flowers of Moringa pterygosperme, the horseradish tree, are eaten by the natives of India in their curries.

The large and showy flowers of Tropæolum majus, the Indian cress or nasturtium, are frequently used along with the young leaves as a salad. They have a warm taste, not unlike that of the common cress, and it is from this circumstance that the plant has obtained the name of nasturtium.

The young calices of Dillenia scabrella, and D. speciosa, which are swollen and fleshy, have a pleasantly acid taste and are used by the inhabitants of Chittagong and Bengal in their curries and also for making jelly.

The flowers of Rhododendron arboreum are eaten by the hill people of India, and are made into a jelly by the European visitors. Yet poisonous properties are usually ascribed to the species of this genus, and it has been said that the R. Ponticum was the plant from whose flowers the bees of Pontus collected the honey that produced the extraordinary symptoms of poisoning described as having attacked the Greek soldiers in the famous retreat of the ten thousand.

The flower buds of Zygophyllum Fabago are used as a substitute for capers, and the flowers of Melianthus major, a plant of the same order, are so full of honey that the natives of Good Hope, where the plant grows wild, obtain it for food by shaking the branches, when it falls in a heavy shower.

Coccoloba urifera is remarkable from the peculiarity of the calyx, which becomes pulpy and of a violet color, whence the plant is called the seaside grape. This pulpy calyx has an agreeable acid flavor and is edible.

The flower stalks of Hovenia dulcis become extremely large and succulent and are used in China as a fruit. It is said that in flavor they resemble a ripe pear.

The flowers of the pumpkin were cooked and eaten by some of the tribes of the American Indians, especially by the Aztecs, by whom they were highly esteemed.

The cauliflower, which has been known from remote antiquity, differs in a remarkable manner from all the other varieties of the cabbage tribe, whose leaves and stalks alone are used for culinary purposes. Instead of the latter being used, the flower buds and fleshy flower stalks, which form themselves into a firm cluster or head varying from four to eight or more inches in diameter, here become the edible portion and one of the greatest of vegetable delicacies.

The flower buds of Capparis spinosa, a plant which grows on walls, etc., in the south of Europe, are pickled in vinegar in Italy and form what are commonly known as capers. These are chiefly imported from Sicily, though the plant is largely cultivated in some parts of France.

The cloves of commerce are the unexpanded flower buds of Caryophyllus aromaticus (Myrtaceæ), a small evergreen, native of the Moluccas, but cultivated in several parts of the East and West Indies. Before the expansion of the flowers, which are produced in branched panicles at the extremity of the branches and are of a delicate peach color, the buds are collected by hand, or else sheets and mats are spread under the tree and the buds brought down by beating it with sticks. They are cleaned and then dried in the sun. A uniform brown color is imparted by slightly smoking them over a wood fire. The flower buds of Calyptranthes aromaticus, another plant of the same order, may be advantageously substituted.

The flower buds and the berries of the myrtle, Myrtus communis, were eaten as spices by the ancients, and are still used in Tuscany instead of pepper.

Long pepper is furnished by the immature spikes of flowers of Chavica Roxburghii, which are gathered and dried in the sun. In chemical composition and qualities it resembles ordinary black pepper and contains piperine.

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THE CATASTROPHE IN BRUX.

Brux, one of the most flourishing cities of Bohemia, has suffered from a catastrophe the results of which cannot be estimated. It is one of the coal-producing centers and lies at the foot of the Erzgebirge, surrounded by a beautiful and fertile country. The region is particularly fortunate, for it has not only the mines in which thousands earn their bread, but the land is so good that the agriculturist is well paid for his work. Who would have imagined that the most elegant part of the city would be laid waste in a night, the owners of fine residences barely escaping with their lives?

In the evening of Friday, July 19, while a fête was in progress, clouds gathered and a heavy storm with thunder and lightning broke over the city. Suddenly, at half past nine o'clock, all gaslights in the city were extinguished; very soon after there was a rumor that a part of the Bahnhofstrasse had caved in, and it was evident to all that there had been a landslide, such as often occurs in the neighborhood, on account of the shifting sands. As soon as the danger was realized, the houses on the street were cleared and the threatened district cut off by a military cordon. The catastrophe progressed rapidly. A one-story house fell in and holes a yard in diameter were made in the middle of the street; more houses fell, and an immense opening was formed in front of the Hotel Siegel; soon after the hotel fell with a great noise, and flames burst forth which spread to the neighboring houses; then a two-story house on Johnsdorfstrasse sank suddenly, leaving only the roof visible; after a pause more houses fell, and all this time a heavy rain was falling. Those who were fleeing from the houses were only lightly clothed and were drenched to the skin. The school houses and parts of the breweries were thrown open, but still many were left without a roof to cover them and had to be taken care of by any who could make room for them. There was great suffering among the homeless people. Twenty-five houses fell and at least one hundred more were pronounced unsafe. As there was no gas, the streets were lighted only by lamps and candles placed in the windows of the houses. The next morning the streets near the ruined district presented a sad picture of destruction; furniture, pictures, and household goods of all kinds were lying about in confusion. The fear of further disaster was so great that many left the city, but the military and the fire companies set to work to save all that could be saved. It is wonderful that, in spite of the suddenness of the disaster, no lives were lost.

THE CATASTROPHE AT BRÜX—A RUINED HOUSE ON GASGASSE.

Prof. Friedrich Steiner, a high authority, explains the catastrophe, in the Bohemia, as follows: "The geological conditions at Brüx are similar to those in many coal regions. Between the watertight clay which covers the coal, making its removal easier, are layers of sand in which the particles are extremely minute. If this sand is saturated with water, it has the consistency of honey and flows out of any opening, as sirup does from a cask. A caving in of the surface caused by the shifting of the sand is not uncommon in the coal regions. A hole bored for driving a support through the watertight strata and, perhaps, reaching the strata of shifting sand, may cause hundreds of cubic yards of the semi-fluid mass to flow into the cavity underground, in a short space of time. An accident of this kind occurred in the Rudnei mine, near Bilin, some years ago. In the coal mines on the border between Saxony and Prussia these shifting sands are the worst enemy of the miner. If this semi-fluid mass flows into the excavation, the strata above lose their support and slowly follow it, forming funnels and even holes of greater or less diameter which are not dangerous if there are no buildings on the sinking ground. If this is the case, however, the buildings fall gradually as the support of the ground is removed by the discharge of the sand. If the water in the quicksand is under high pressure, a bore made downward from the surface of the ground may cause an upward flow of the semi-fluid mass. The accident at Schneidemuhl was caused in this way. In such cases we have a slow trembling of the earth, as in earthquakes. The occurrence and extent of such a sinking of the ground depends upon local conditions, and cannot possibly be foretold without the most careful study of existing circumstances. Science possesses means for boring into such strata of sand with safety; one of the most ingenious of these is the freezing method of Engineer Poetsch, who freezes the mass by circulating, through pipes, a solution of calcic chloride that has been reduced to a very low temperature. Another method consists of draining the strata of sand by means of driven pipes covered with asbestos or similar material, thereby reducing the consistency of the mass to that of moist sand that will not flow or shift. Sometimes a discharge of this kind will stop of itself, if the water is quickly drained off, so the strata are enabled to resist displacement." Prof. Steiner does not think it probable that there was a direct caving in of the mine under the city on account of thoughtless cutting. It will of course be understood that such casualties are an impossibility for a city, like Prague, for instance, that stands on firm ground. The water and gas mains that lie in sinking ground break, and consequently they fail to deliver their supplies, a natural consequence which can be observed on a small scale in the settling of newly upturned ground.

Many people in good circumstances have been reduced to beggary by the Brüx catastrophe. A committee was formed to ameliorate the condition of the sufferers, and donations were received from all sides. The Emperor Franz Joseph sent $700 immediately upon receipt of the news. The traces of devastation will be gradually removed and the destroyed homes built up again. It is to be hoped that the city may be restored to its former prosperous condition.—Illustrirte Zeitung.

Paint for Ships' Bottoms.

One lb. of India rubber "previously masticated" is passed between rollers to render it non-elastic, all the pigments required in the finished paint being added during the operation. It is then dissolved in 20 lb. of turpentine or similar liquid, 12 lb. of copal in the form of varnish, and 2 per cent of boiled oil being ground in to complete the composition. The claim is for the use of India rubber, treated as specified, and united with the ingredients mentioned, for producing an "anti-salt paint."

Spider Farming.

Although entomologists have often raised spiders for purposes of scientific observation and investigation, spider raising as a money-making industry is something rather novel. One has only to go four miles from Philadelphia, on the old Lancaster pike, says a Philadelphia paper, and ask for the farm of Pierre Grantaire to see what can be found nowhere else in this country, and abroad only in a little French village in the Department of the Loire.

Pierre Grantaire furnishes spiders at so much per hundred for distribution in the wine vaults of merchants and the nouveaux riches. His trade is chiefly with the wholesale merchant, who is able to stock a cellar with new, shining, freshly labeled bottles, and in three months see them veiled with filmy cobwebs, so that the effect of twenty years of storage is secured at a small cost. The effect upon a customer can be imagined, and is hardly to be measured in dollars and cents. It is a trifling matter to cover the bins with dust, but to cover them with cobwebs spun from cork to cork, and that drape the neck like delicate lace, the seal of years of slow mellowing, that is a different matter. The walls of Mr. Grantaire's spider house are covered with wire squares from six inches to a foot across, and behind these screens the walls are covered with rough planking. There are cracks between the boards apparently left with design, and their weatherbeaten surfaces are dotted with knot holes and splintered crevices. Long tables running the length of the room are covered with small wire frames, wooden boxes and glass jars. All of these wires in the room are covered with patterns of lace drapery, in the geometrical outlines fashioned by the spider artists. The sunlight streaming through the door shows the room hung with curtains of elfin-woven lacework.

It is not all kinds of spiders that make webs suitable for the purposes of the wine merchant, and those selected by Mr. Grantaire are species that weave fine, large ones of lines and circles. They are the only webs that look artistic in the wine cellar or on the bottles. The spiders that weave these are principally the Epeira vulgaris and Nephila plumipes.

When Mr. Grantaire has an order from a wine merchant, he places the spiders in small paper boxes, a pair in a box, and ships them in a crate with many holes for the ingress of air. The price asked, ten dollars a hundred, well repays the wine merchant, who, at an expenditure of forty or fifty dollars, may sell his stock of wine for a thousand or more dollars above what he could have obtained for it before the spiders dressed his bottles in the robes of long ago. Mr. Grantaire has on hand, at a time, 10,000 spiders, old and young, the eggs of some of which, the choicest, he obtains from France.

When the mother spider wishes to lay her eggs, she makes a small web in a broad crack, then she lays say fifty eggs, which she covers with a soft silk cocoon. In two weeks (or longer in winter) the eggs begin to hatch, an operation that takes one or two days. The egg shells crack off in flakes, and the young spiders have a struggle to emerge. Then they begin to grow, and in a week look like spiders. They often moult, and shed their skins like snakes. The brood has to be separated at a tender age, else the members of the family would devour each other until only one was left.

Zinc Plate for Lithographic Printing.

Lime or calcium chloride is dissolved in water. To the solution alum is added and the mixture stirred to the consistency of a thick creamy paste. Water, nitrous acid, and finally zinc sulphate are successively added with further stirring. In the solution thus prepared a sheet of zinc is steeped for a few minutes, then rinsed with water, and the grayish-black film removed with a sponge or brush. The plate may now be employed with advantage as a substitute for the ordinary lithographic stone.—E. T. Beal, Hull, Eng.

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Varnish Trees.

The order Anacardiaceæ, or Terebinths, comprises trees or shrubs that yield a resinous, gummy, or milky juice, which, although usually acrid and highly poisonous, yields products of economic or commercial importance. Such is the case, for example, with the Anacardium occidentale, a large tree with the aspect of a walnut tree, which is cultivated in the West Indies and other warm countries for its fruits, which are known as cashew nuts. The stem of this tree furnishes a milky juice, which, as it dries, becomes black and hard and is used in India as a varnish. A gum is also secreted by this plant that has qualities like those of gum arabic. It is exported to Europe from South America under the name of cadjii gum.

The varnish of Sylhet is chiefly procured from Semecarpus Anacardinum, the marking nut tree of India. The juice of this tree, when dry, forms a black varnish much used in India, and, among other purposes, is employed, mixed with pitch and tar, in the calking of ships.

Melanorrhœa usitatissima, the theet-su of Tenasserim and the kheu of Manipur, produces wood that is so hard and heavy that anchors for native boats are made of it. The most valuable and extensively used product of the tree, however, is the black lacquer that it yields, and which is known as Martaban varnish. This is obtained by the process of tapping; short joints of bamboo closed at the bottom being thrust into holes bored in the trunk and left for two days, when they become full of a whitish thick juice which turns black when exposed to the air, and requires to be kept under water in order to preserve it. All kinds of domestic utensils and furniture are lacquered with this juice, which is laid on thin, and slowly dried, the change from black to white being, according to Sir D. Brewster, attributable to its losing its organized structure and becoming homogeneous, and then transmitting the sun's rays, which, in its previously organized state, it dispersed.

Such a secretion is probably the substance mentioned by Ainslie as the black lac of the Burma country, with which the natives lacquer various kinds of ware.

The valuable hard black varnish called Japan lacquer is obtained from Stagmaria verniciflua of the Indian Archipelago. This resin is extremely acrid and the people of Sumatra consider it dangerous even to sit or sleep beneath the shade of the tree that yields it. The manner of preparing the varnish is fully described in Jack's Malayan Miscellanies.

From the stem of Holigarna longifolia, a lofty Indian tree, the natives of Malacca extract an acrid juice which they use as a varnish. The stone of the fruit likewise contains an acrid resinous juice which is employed for the same purpose, while the investing pulp contains a glutinous fluid which is made use of by painters, and for fixing colors on linen.

Augia Chinensis produces a varnish which is used in China and Siam. Odina Wodier, Buchanania latifolia and many more Indian species, yield a juice having the same property.

The fresh juicy bark of Schinus Arroeira is used in Brazil for rubbing newly made ropes, which it covers with a very durable bright dark brown varnish.

Mastic, a resin used for varnishing pictures, is obtained by making incisions in the bark of Pistacia Lentiscus, a small tree indigenous to Southern Europe and Western Asia. The juice of many species of Rhus is milky, stains black, and is sometimes extremely venomous. R. vernicifera, a small Japanese tree, yields the famous lacquer so extensively employed by the inhabitants of that country for lacquering various articles of furniture and small ware. It exudes from wounds made in the tree, and is at first a milky juice, but becomes darker and ultimately black on being exposed to the air. There are about twenty different kinds of this lac in the Japanese market. The juice of R. vernix and R. succedaneum possesses similar properties.

The order Dipteraceæ includes gigantic trees abounding in resinous juice, and found in India and especially in the eastern islands of the Indian Archipelago.

One of these, Vateria Indica, furnishes the resin called copal in India (and gum anime in England), and very nearly approaching the true resin of that name. It is also called white dammar and gumanine. In its recent and fluid state it is used in the south of India as a varnish (called piney varnish) for carriages, pictures, etc., and, dissolved by heat in closed vessels, is employed for the same purpose in other parts of India. It is extremely tenacious and solid, but melts at a temperature of 97·5° Fah. The resin is procured by cutting a notch in the tree, so that the juice may flow out and become hardened by exposure to the air. The gum resin known as Brazilian copal is obtained from several species of Hymenœa and from Trachylobium Martianum; Madagascar copal from Hymenœa verrucosa; and Mexican copal from Elæocarpus copallifera and Rhus copallinum.

Callitris quadrivalvis, a coniferous tree of Barbary, yields the whitish yellow brittle resin known as sandarac, which is used in varnish making.

Kauri resin is a product of Dammara Australis, a New Zealand conifer reaching a height of from 150 to 200 feet. The resin is hard and brittle like copal. It exudes chiefly from the lower portions of the trunk, either from natural fissures or from wounds purposely made with an ax. It is at first of about the consistency and color of cream, highly glutinous and flavored like turpentine, but gradually hardens by exposure to the air and changes to a dark color. The best resin is found by digging in the ground where old forests have been destroyed, and it is found from a few inches to as many feet in depth, and in localities now denuded of trees. It is also found in the soil at the base of living trees.

The fine transparent resin used in the manufacture of varnish under the name of damar or dammar is the product of the Amboyna pine, Dammara Orientalis, a native of the Moluccas.

Elæagia utilis, a lofty cinchonaceous tree of the Cordilleras, is remarkable for the quantity of green resinous or waxy matter secreted by the stipules and which invests the unexpanded buds. The resin is collected by the natives and employed by them to varnish boxes and many other useful or ornamental objects. The natives call this tree by a name signifying wax or varnish tree.

Herz's Telegraph Invention.

In a recent interview Dr. Cornelius Herz, at present a fugitive from French justice at Bournemouth, England, and who is described as worn with anxiety and pain and clearly dying, declared in broken utterances that he would leave a great invention to be patented and developed. The gist of the invention is an enormous improvement in telegraphy, by which more than 1,000 words can be transmitted by long submarine cables in the same time that 20 words can be sent now. The invention, the doctor claimed, would allow of cabling 50 words at a cost of five cents. He dwelt upon the influence that the invention would have upon the newspaper of the future, and said that he intended, in granting royalties, to reserve all rights as far as they applied to news. The invention, he said, would render submarine telephony and multiplex telephony feasible. Among those engaged in his laboratories in France on the experiments which have resulted in the invention he mentioned Edison's nephew.

RECENTLY PATENTED INVENTIONS.

Electrical.

COMMUTATOR BRUSH HOLDER.—George J. Junker, Mount Vernon, Ill. This invention provides for the construction of a commutator in which the different coils of the armature may be in series or in parallel, and the current taken off from each coil separately, permitting of supplying as many circuits as there are coils. The commutator is formed of a series of bisected rings mounted on the armature shaft, insulated from each other and from the shaft, with the halves of each ring insulated from each other, and with the terminals of each coil on the armature connected with the halves of one of the commutator rings. The terminals of the coils are all extended parallel with the shaft and insulated from all the commutator rings except the ones to which they properly belong.

Mechanical.

NUT LOCK.—William Woolcock, Shamokin, Pa. This is an improvement in nut locks in which the nut is secured on the bolt by means of a washer, or by a supplemental nut applied to a reduced portion of the bolt. Combined with a bolt having a reduced polygonal extension is a nut having a threaded boss on which a cap nut is adapted to screw, a ratchet being applied to the bolt extension, in connection with a pawl and spring.

Railway Appliances.

SAFETY CAR BRAKE.—Jefferson U. Elwood, McKeesport, Pa. This is a brake especially applicable to street cars, and for use in conjunction with the ordinary brakes. Secured to the car truck are vertically sliding transversely slotted brake shoe holders in brackets, there being wedge-shaped shoes adjustable in the holders. The brakes frictionally engage the track rails, and work on a curve as well as on a straight line. The handle mechanism for working the brake is applied to an ordinary brake shaft, not interfering with the working of the latter.

Agricultural.

CORN SHELLER.—Albert Peterson, Cambridge, Ill. A machine adapted to cut up fodder with corn ears thereon, and then separate the shelled corn from the fodder and cobs, is provided by this inventor. The driving shaft may be turned either by hand or power, and the shelling and separating mechanism are so arranged that it may be used in connection with an ordinary corn cutter, and made to shell corn very rapidly and clean it nicely.

Miscellaneous.

WINDMILL.—Saunder Saundersen, Northwood, North Dakota. This mill is designed to permit the paddles, when the wind blows strongly, to be forced perpendicularly edgewise to the wind, thus spilling sufficient wind to prevent the wheel being revolved too fast. Should the wind blow very strong, the paddles will be forced edgewise to afford open passage through the wheel, as though the mill were out of gear. By means of a simple mechanism the wheel may be stopped from the ground or its speed slackened. An auxiliary wind wheel is provided at the tail of the mill which automatically acts to carry the main wheel into the wind, should the wind shift.

SURFACE CONDENSER.—Albert Hoberecht, Ensenada, Mexico. A series of steam or fluid condensing tubes is arranged in tiers, according to this invention, air spaces surrounding each tier of tubes held independent of but communicating with each other, an air supply being connected with such spaces, while air tubes are passed through the steam tubes and independent air-supplying means connected with each tier of air tubes. The improvement is adapted for use with stationary, marine, or locomotive engines, and also for condensing spirits in all kinds of distilleries and breweries, operating without the use of water or other agency except air from a stack or artificial draught.

DRIER FOR COFFEE, GRAIN, ETC.—Emilio C. y Echeandia, Las Marias, Porto Rico. This apparatus provides for the ready insertion and removal of the material to be dried, the arrangement being such that all the grains will be thoroughly and similarly heated, the drier being designed to work thoroughly and with great rapidity. It comprises a revoluble cylinder having closed ends, a series of communicating circumferential compartments with perforated inner and outer walls, and a heater arranged within the cylinder.

PLUMB AND LEVEL.—William Moore, Long Island City, N. Y. This is a tool in which both the plumb and the level tubes may be adjusted simultaneously by the movement of a single screw, the glasses being so set that they will maintain their adjustment for a maximum of time. The plumb and level glasses are so located that the tool may be used conveniently either in plumbing work below or above the operator. The plumb and level glasses are virtually one, but partitions render the plumb and level compartments of the continuous glass independent.

SASH HOLDER.—Charles West, Englewood, N. J. This invention relates to sliding sashes such as used on carriage doors, and provides a sash which will not rattle, which will remain in any position to which it may have been adjusted, and which may be used with carriage doors having grooves or guideways of different shapes. The sash has at the sides of its upper portion opposing spring-pressed swiveled leaves, arranged to move yieldingly perpendicular to the plane of the sash, there being guides lower down in the same plane with the leaves.

GAME COUNTER.—Charles H. Isburgh, Melrose, Mass. This is a light, cheap and positive indicator for keeping account of the number of points played in games of cards, dominos, etc. It is a permanent attachment to or a portion of a table, and when the score is recorded it is immediately placed before each of the players, the change of score requiring but very simple and slight manipulation.

CABINET.—Peter Ullrich, Cedar Rapids, Iowa. This is a cabinet to receive checks, tickets and similar articles, and has a roll front moving in grooves adapted to close its open side, a brake device engaging the movable front and holding it in place wherever it may be fixed.

TIGHTENING DRUMHEADS, ETC.—Isaac H. Sapp, Bucyrus, Ohio. According to this improvement a tension band is passed around the head of the drum, banjo or similar instrument, inside the point of its attachment to the body, and a tension device is connected with the band, whereby it may be made to bind more or less firmly against the head. The tightening may thus be effected quickly and conveniently, and the instrument not be bound by the numerous tightening devices usually employed.

GAME APPARATUS.—Joel Northrup, Otisville, N. Y. For playing jackstones in a novel manner this inventor has devised a flanged playboard in which is held a removable causeway provided with a series of devices for the reception and passage of the jackstones. The places in the causeway to receive the jackstones are of different forms and the game may be varied by the obstructions, hazards and hindrances placed in the causeway or on the board.

TOILET PAPER HOLDER.—William L. Pattiani, Alameda, Cal. This inventor provides a case in which the sheets may be held in position for convenient removal, the case when not in use being folded up compactly against any convenient support.

Designs.

HAND BAG.—Henry Bruning, Brooklyn, N. Y. The leading feature of this design consists in a bag body the whole lower end of which is surrounded by an annular band.

SPOON.—George P. Tilton, Newburyport, Mass. The bowl of this spoon is divided into a number of lengthwise ranging curved surfaces which follow the longitudinal curves of the bowl and are narrow both at the point and inner end of the bowl.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

A MANUAL OF MARINE ENGINEERING. By A. E. Seaton. London: Charles Griffin & Company, Limited. New York: D. Van Nostrand Company. 1895. Pp. 585. 8vo, 140 illustrations, plates. Price $6.

This is the twelfth revised and enlarged edition of a standard work. The book was first prepared to supply the want of a treatise on the application of theoretical principles to the design and construction of marine machinery as determined by the experience of leading engineers and carried out in the most recent successful practice. The data on which the book is based was collected during many years of study and practical work on the part of the eminent author. In 1880, the triple compound engine was little more than a dream, the highest boiler pressure used by advanced engineers was 100 pounds per square inch, steel crank shafts and other heavy forgings were looked upon as luxuries to be indulged in only by governments and wealthy corporations. To-day all these conditions are changed. Most of these changes in engineering practice were gradually introduced, so that it was not difficult by slight emendations and additions to bring the book up to date at each new edition, but other changes have been so rapid as to require the entire remodeling of the book. On the whole, it is one of the most useful books ever written on the subject and has the advantage of being fully up to the best modern practice.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Vol. XI. New York: Published by the Institute. 1894. Pp. 938. 8vo, illustrations, plates.

This volume contains a large number of papers with discussion by prominent electricians including William A. Anthony, R. W. Pope, E. J. Houston, Joseph Wetzler, A. E. Kennelly, C. O. Mailloux, Carl Hering, C. P. Steinmetz and others. One of the most interesting and timely articles is that of Isaiah H. Farnham on "Destructive Effect of Electrical Currents on Subterranean Metal Pipes," showing the condition of affairs in Boston. We learn from it that the Omaha plumbers apply the name of "smallpox pipe" to those pipes which are pitted by electrolysis. "The Electric Brake in Practice," by Elmer A. Sperry, is another important paper, while that of Prof. George D. Shepardson on "Suggestions for an Index of Engineering Literature" offers many plans for indexing the vast amount of literature which has appeared on this subject. In the back is a diagram or table called "Diseases of Dynamos," compiled and arranged by Lieut. C. D. Parkhurst. This valuable table should find a place in every dynamo room, as it will tell the probable cause of the trouble from the symptoms shown and gives the remedy. The table is very elaborate and undoubtedly represents an immense amount of labor.

DER ZUSTAND DER ANTIKEN ATHENISCHEN BAUWERKE AUF DER BURG UND IN DER STADT. By Professor Dr. Josef Durm. Berlin: Wilhelm Ernst & Sohn. 1895. Pp. 18. 4to, 18 illustrations.

In our SUPPLEMENT, No. 1021, there is an article on the same subject the present condition of the remains at Athens with special reference to their preservation. Dr. Durm's work, however, is not limited to the Parthenon, but includes other monuments. Dr. Durm is particularly fitted to write on the condition of these buildings by his researches on Renaissance buildings, notably the Cathedral of Florence and St. Peter's Church at Rome, which were embodied in his "Die Domkuppel in Florenz und die Kuppel der Peterskirche in Rom." The excellent sketches in Dr. Durm's work on Athens are calculated to give a clear idea of the present ruinous con-

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dition of these important architectural remains. We are glad to be able to say that recent advices from Athens state that the work of preservation, if not of restoration, will not be delayed. As it takes a long time for white Pentelic marble to weather to the present shade of the remains, it is to be hoped that the restorations will be light.

ALGEBRA FOR BEGINNERS. By H. S. Hall and S. R. Knight. Revised and adapted to American schools by Frank L. Sevenoak, A.M., M.D. New York and London: Macmillan & Company. 1895. Pp. 188. 16mo. Price 60 cents.

This excellent work will be found to meet the wants of all who do not require a knowledge of algebra beyond quadratic equations—that portion of the subject usually covered in the examination for admission to the classical course of American colleges.

MATRICULATION DIRECTORY. No. XVIII. June, 1895. London: University Correspondence College. 1894. Pp. 132. 16mo. Price 1s.

This pamphlet belongs to the University Tutorial Series and gives the general method of work by which specially prepared courses of lessons are given for the examinations of the University of London in Arts, Science, Laws, and Music. These courses "embrace all that is requisite for success, yet entirely relieve candidates from superfluous work, the special syllabus of each examination being always kept in view." We have several times called attention to this pernicious system of limiting education to those subjects required for degrees and certificates. The correspondence system of education might be introduced in the United States with advantage to a much larger extent than it has already been. The present Matriculation Directory is of course of little value to the American student, the text-books and methods of instruction being different.

DESIGNING AND PAINTING VITRIFIABLE COLORS ON GLASS MADE ACCESSIBLE TO ALL. By H. P. Saucre. Translated and adapted by Favor Ruhl & Company, New York City. Pp. 53. 16mo, illustrated. Price 60 cents.

This valuable little book is authorized by Lacroix, of Paris, the well known manufacturer vitrifiable colors, and with the aid of the clear descriptions any one who can paint at all should be able to turn out excellent work. The newest methods of work are described.

THE CATHEDRALS OF ENGLAND AND WALES. "The Builder" Series. London: Published by "The Builder," 46 Catherine Street, London, W. C. 1894. Elephant folio. 62 plates and plans on plate and India paper. Detail cuts and descriptive letterpress. Library edition limited to 250 copies. Price, unbound in portfolio, £3 13s. 6d. Bound in whole buckram, £4 4s. American price, $29.40 and $33.60 respectively.

The cathedrals of England are the richest architectural heritage of the English people, and any work devoted to them is sure of attention. We already have many works devoted to them, treating them from the popular and historical side and occasionally from the side of the professional architect as well. They all, no doubt, fulfill a useful purpose, but the present work appears to have been designed on different lines, as at the same time it appeals to the practical architect, the amateur, and to the section of the general public who care for cathedral history and buildings. The views are all entirely new ones, and in many cases the stereotyped "view" which has come down from the time of Winkle's "Cathedral Churches" has been abandoned. Unlike most series of illustrations of this kind, the method of execution is various. The drawings are reproduced according to the modern methods of photo-mechanical work. To architects, the plans will form the most valuable part of the book, as they are drawn on a large scale; in some cases they occupy two pages of the portly volume. The plans are, of course, drawn to scale, and the dates of various portions of the edifices are distinguished by shading, etc. The plans are exceptionally clear, with the possible exception of the Canterbury plan, and give a splendid idea of the arrangement of the cathedral and conventual buildings. It is pleasing to note that many of the smaller cathedrals, which are usually omitted in works of this class, have been adequately treated, as St. David's, Bangor, and St. Asaph. The detail drawings are new, and will prove interesting to both the professional and the amateur. The letterpress is republished from "The Builder." On the whole, the work reflects great credit on those who have had in hand its production and publication, and the meritorious volume is deserving of a large sale.

AN ELEMENTARY TEXT BOOK OF MECHANICS. (The University Tutorial Series.) By William Briggs, M.A., and G. H. Bryan, M.A. London: University Correspondence College Press. 1895. 16mo. Pp. 336, 167 illustrations. Price $1.40.

In preparing the present book it has been the aim of the authors to afford beginners a thorough grounding in those parts of dynamics and statics which can be treated without assuming a previous knowledge of trigonometry. The definitions are excellent and examples are fully worked out. The problems are numerous and the answers are given in the appendix. On the whole, it appears to be an admirable text book.

THE PRINCIPLES OF PHYSICS. By Alfred P. Gage, Ph.D. Boston: Ginn & Company. 1895. 12mo. Pp. 493, illustrations. Price $1.55.

The author published a text book on physics some thirteen years ago entitled "Elements of Physics." The present volume is, however, an entirely new work. The author's views regarding the smallness of text books and the mutilation of the science of physics could be read with advantage by many English educators who are bound down to the syllabus limitation of studies. In arrangement the book does not differ materially from the general run of books on the subject. The method of presentation is clear and logical and a large number of footnotes add to the interest of the work. The exercises, questions, problems and experiments are excellent. The illustrations are a striking feature of the book and it is satisfactory to note that at last a modern telescope (the Lick) and the transformer have got into a text book.

THE MANUFACTURE OF EXPLOSIVES. A Theoretical and Practical Treatise on the History, the Physical and Chemical Properties and the Manufacture of Explosives. By Oscar Guttmann. London: Whittaker & Company, 2 White Hart Street, Paternoster Square. 1895. 2 vols. Pp. 782, xlix, 147 illustrations. Price $9.

A really good book on explosives has been needed for a long time, and the present work seems to have been written by a person thoroughly conversant with his subject. The introduction of the dynamites for civil and of guncotton and picrates for military engineering operations, and the general adoption of small bore magazine rifles and smokeless powders has completely revolutionized the subject of explosives, and rendered many of the old books useless. The present work is not a bare catalogue of modern explosives, but is a technical work, dealing with their manufacture on a commercial scale by the latest and most approved methods. An admirable feature of the book is that under nearly every engraving will be found the scale on which it is drawn, so that a correct idea may be obtained of the dimensions of various parts of the machine. This does not apply only to plans, but to the shaded drawings. The same idea could be carried out to advantage in most technical books. The work treats of powders of all kinds, guncotton, nitroglycerine, fulminates, dynamite, sprengel explosives, etc. The bibliography of explosives is very full, and is one of the most important features of the book, and even includes works published in 1895. On the whole, the work is an admirable addition to technical literature.

POSITION DIAGRAM OF CYLINDER WITH MEYER CUT-OFF AT ONE-EIGHTH, ONE-FOURTH, THREE-EIGHTHS AND ONE-HALF STROKE OF PISTON. New York: Spon & Chamberlain, 12 Cortlandt Street. 1895. Price 25 cents.

The valves may be adjusted by pulling the slips on the underside of the card. Such diagrams are of great assistance in comprehending a difficult subject.

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AUGUST, 1895.—(No. 118.)

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5. A cottage in the suburbs of Brooklyn, N. Y., erected at a cost of $7,500 complete. Perspective elevation and floor plans. Architects, Messrs. J. C. Cady & Co., New York City. An artistic design.
6. Two perspective elevations and floor plans of "Lover's Dell," a residence recently erected in New Jersey. A pleasing example for a modern Colonial dwelling. Architect, Oscar S. Teal, New York City.
7. A residence at Sea Side Park, Bridgeport, Conn. Two perspective elevations and floor plans. An exquisite design. Architect, Mr. W. R. Briggs, Bridgeport, Conn.
8. A residence in the Colonial style, recently erected at Chester Hill, Mt. Vernon, N. Y. Three perspective elevations and floor plans. A picturesque design. Lewis H. Lucas, architect, New York City.
9. Ground plan and perspective view of Holy Trinity Church, Harlem, N. Y. Architect, Mr. Wm. A. Potter, New York City.
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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

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(6606) T. J. S. writes: Please give me a receipt for enamel for bicycles. A. Enamel black for cycles: Asphalt, 40 ounces; boiled linseed oil, ½ gallon; litharge, 6 ounces; powdered zinc sulphate, 4 ounces; red lead, 6 ounces; litharge, 6 ounces. Melt the asphalt, add the others; boil 2 hours, stir in 8 ounces fused dark amber gum and 1 pint hot linseed oil; boil 2 hours more. When mass has thickened remove from the fire and thin 1 gallon turpentine.

(6607) H. F. says: 1. Will you kindly inform me how I can crystallize flowers? A. Crystallized grasses and sprays are made as follows: The bunches are first arranged in a suitable manner, tied and secured; a solution of four ounces alum to 1 quart boiling water is made, and when this has cooled to about 90° or blood heat, the bunch of grass and leaves is suspended in it, in a deep jar, from a rod placed across the mouth of it; as the liquid cools, crystals of alum are deposited upon every spray, the finer and smaller, the weaker the solution is made. This deposit of crystals occurs in the cooling liquid, because hot water dissolves more alum than cold water, and as the water cools, the excess of alum forms crystals which attach themselves to any fibrous matter in contact with it more readily than to anything else. These crystals enlarge by accretion constantly, as long as there is an excess of alum in the solution. When the supply is exhausted, the solution is warmed and more alum is dissolved in it: it is returned to the jar and the bunch of grasses is replaced. When sufficiently covered with crystals it is taken out and dried and is finished. 2. How to prepare the solution for illuminating the face of a clock so the time can be seen at night? A. Use luminous paint, which you can buy ready prepared.

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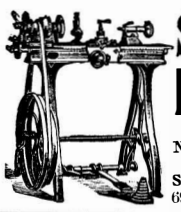

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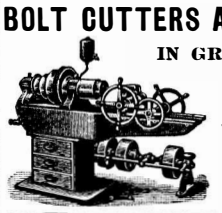

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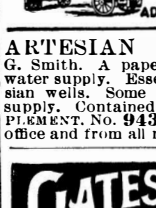

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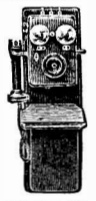

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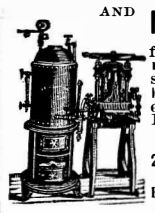

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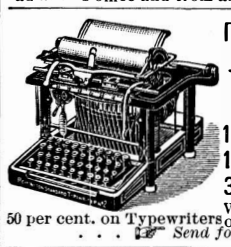

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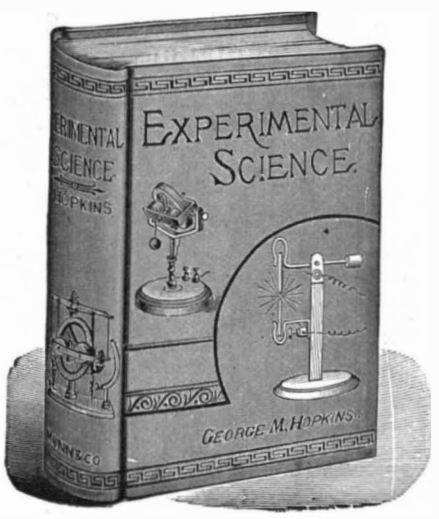

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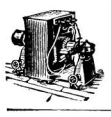

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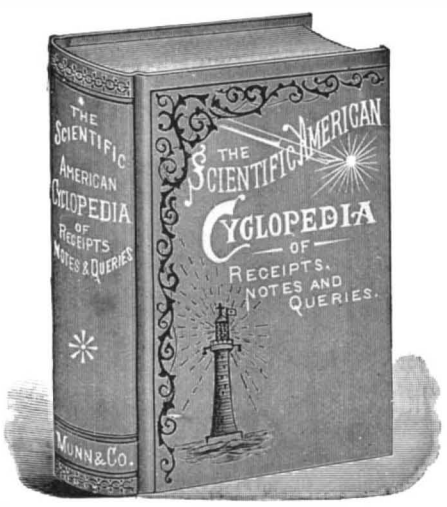

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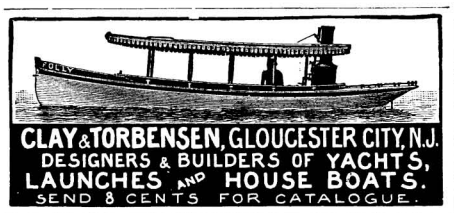

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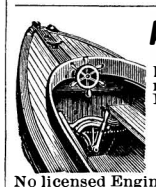

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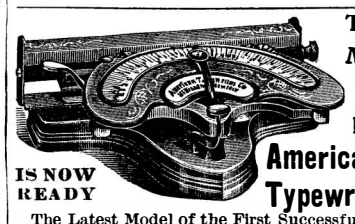

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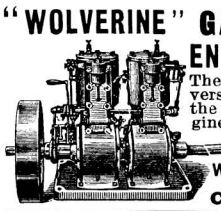

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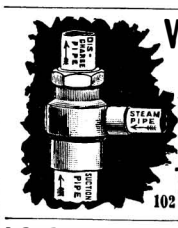

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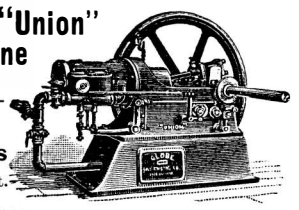

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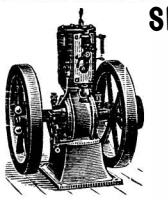

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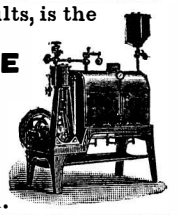

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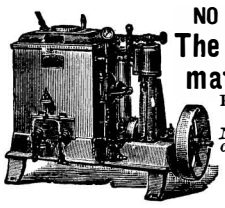

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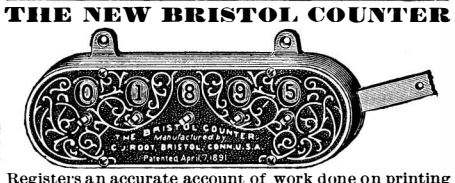

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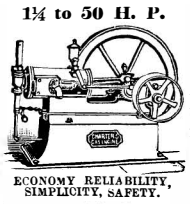

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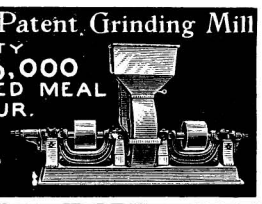

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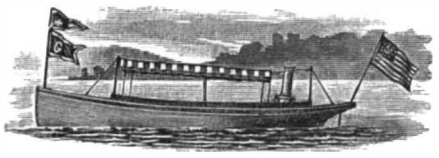

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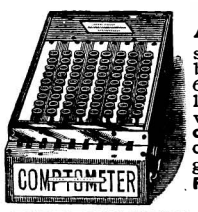

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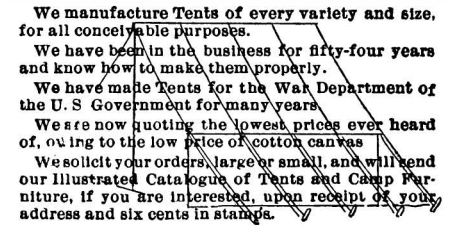

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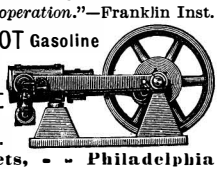

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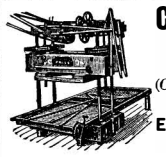

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